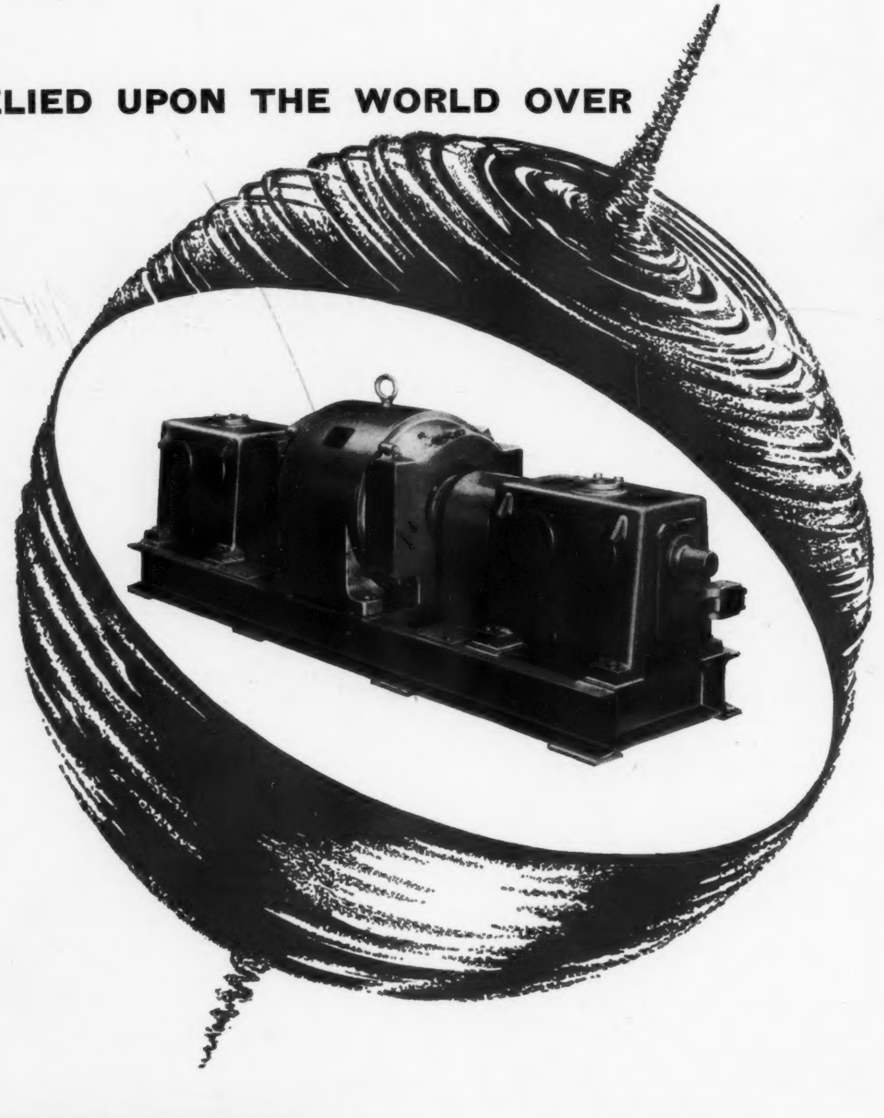
MACHINERY

JUNE 14, 1961 ONE SHILLING & THREEPENCE

RELIED UPON THE WORLD OVER



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RODLEY NEAR LEEDS ENGLAND
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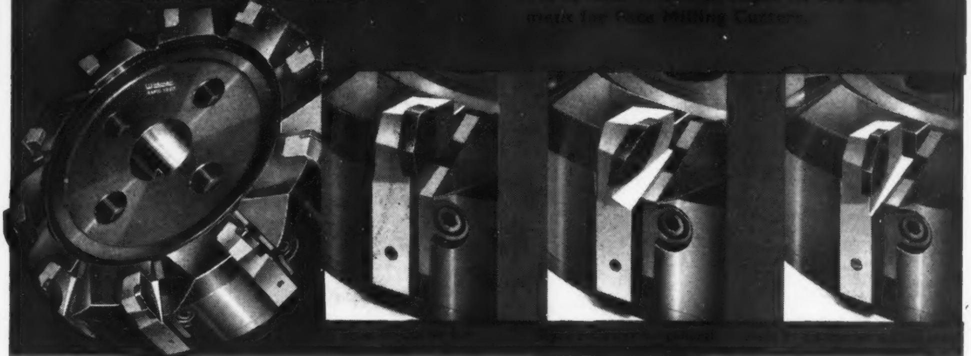
RAPID RE-SET

Face Milling Cutters

Secure ——
RAPID BLADE RE-SETTING
RAPID RE-SERVICING
REDUCED CUTTER DOWN TIME
REDUCED CUTTER COSTS

The Wickman Rapid Re-set system brings even higher efficiency in production milling. Reservicing of Milling Cutters is quicker and simpler by utilising the off-hand grinding method together with the Special Wickman Rapid Re-set Equipment for Face Milling Cutters.

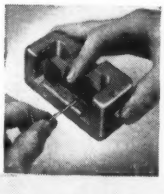


RAPID RE-SET EQUIPMENT

The use of the Wickman Rapid Re-set Cutter Body and three blade styles available provides a simple variation of blade geometry. The blades can be removed, re-ground, checked and replaced in any Cutter Body size within the range—WITHOUT REMOVING THE CUTTER BODY FROM THE MACHINE, thus reducing down times and costs to a minimum.

GRIND—with special jig

GAUGE—for accuracy



RE-SET—in setting block

WRITE FOR YOUR COPY OF THE NEW WICKMAN FOLDER "WICKMAN RAPID RE-SET FACE MILLING CUTTERS" FOR THE FULL STORY.

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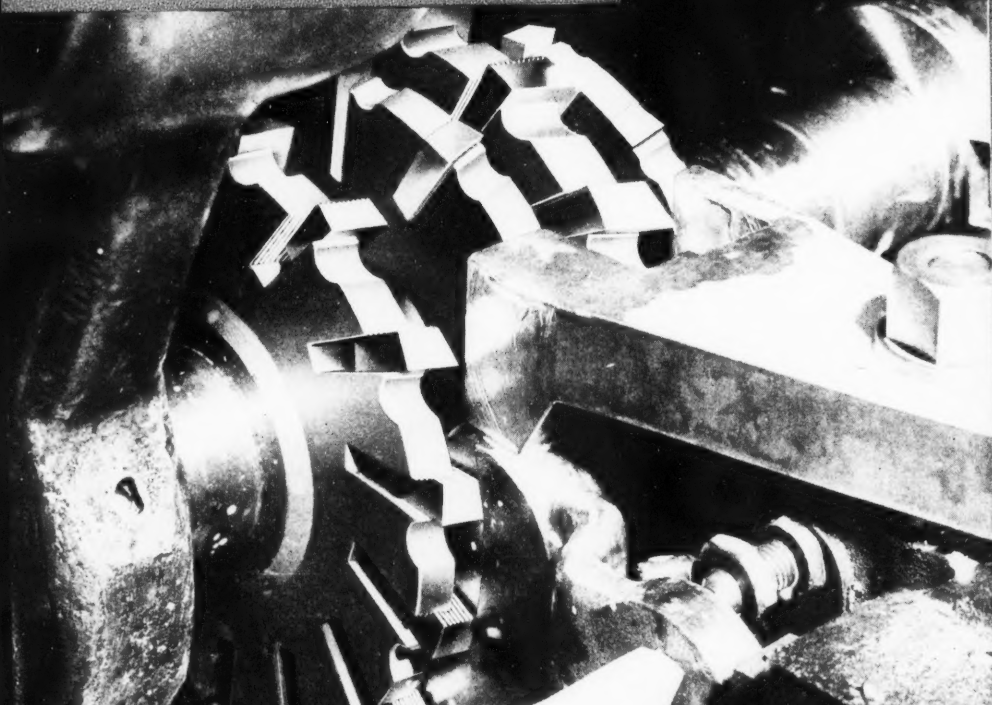
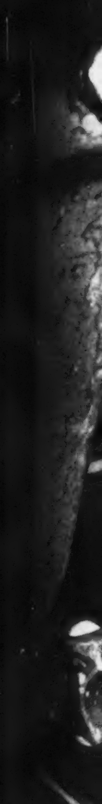
TRADE MARK



Front engine shackles are set-up in pairs and straddle milled to width as shown.



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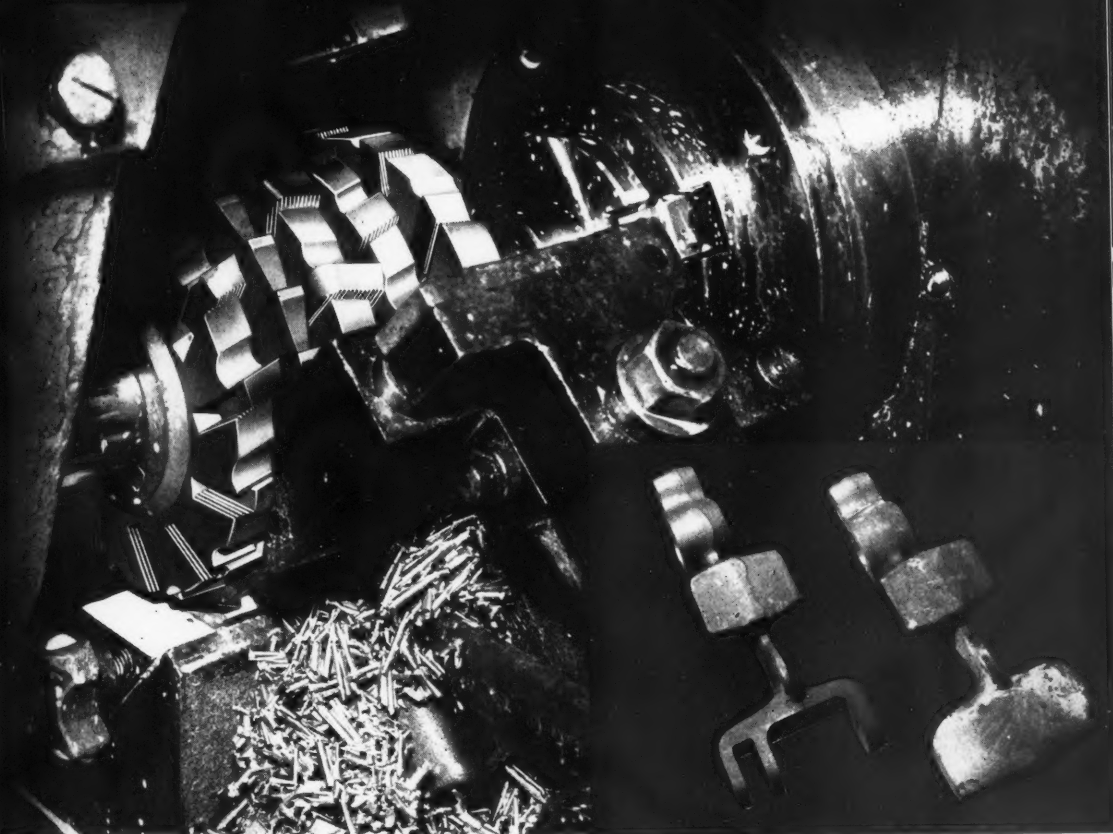
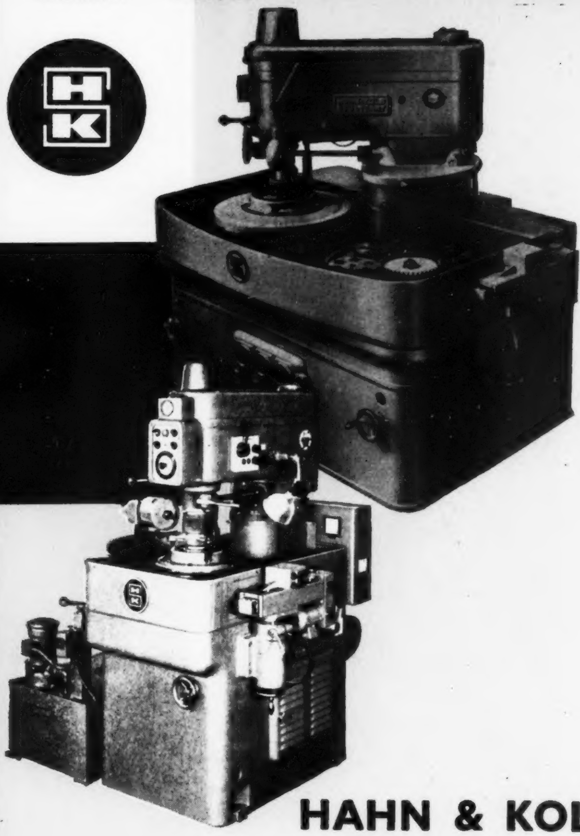



Extra
Holes!

ALES-
SSOC



LAPPING AND FINE GRINDING MACHINES

a HAHN & KOLB design

for finishing cylindrical or flat components on one or two parallel sides either by lapping with cast-iron wheels or fine grinding with abrasive wheels.

range includes—

Models ZL500, LHD Ia and DUPLEX DLI.

Illustrations show

Top : Model DUPLEX DLI with 2 bottom wheels.

Bottom : Model ZL 500 with one bottom wheel and automatic feeding of compound.

HAHN & KOLB (Great Britain) LTD.

243-245 Horn Lane, Acton, London, W.3.

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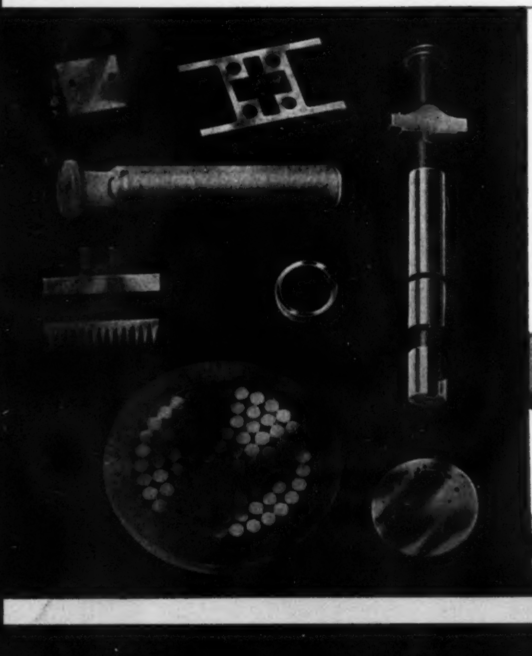

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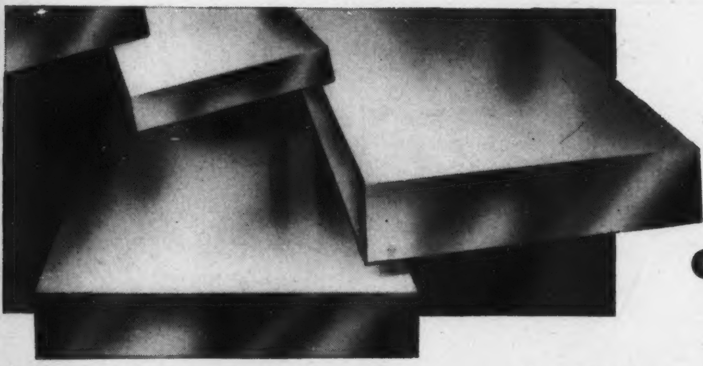

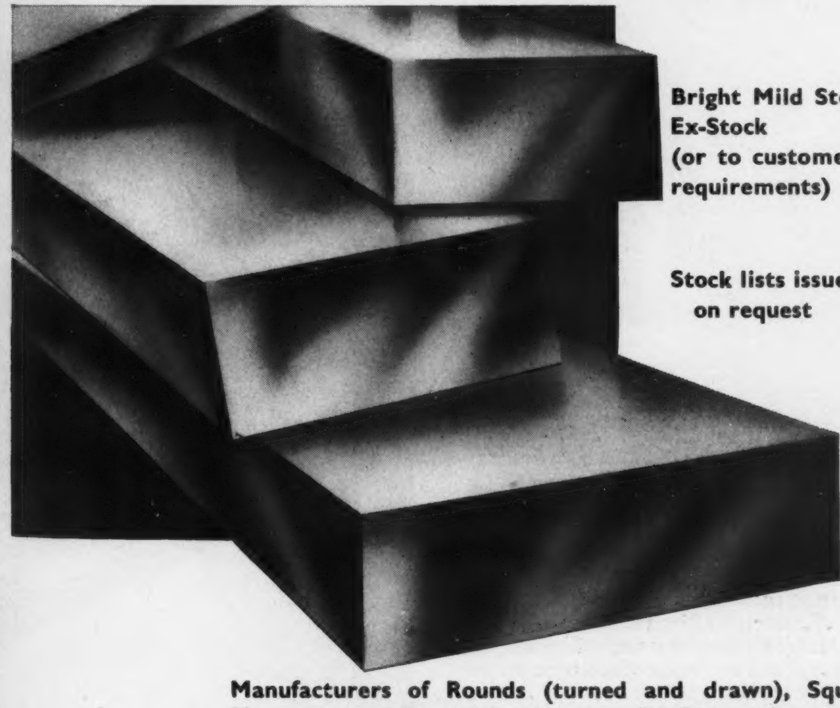


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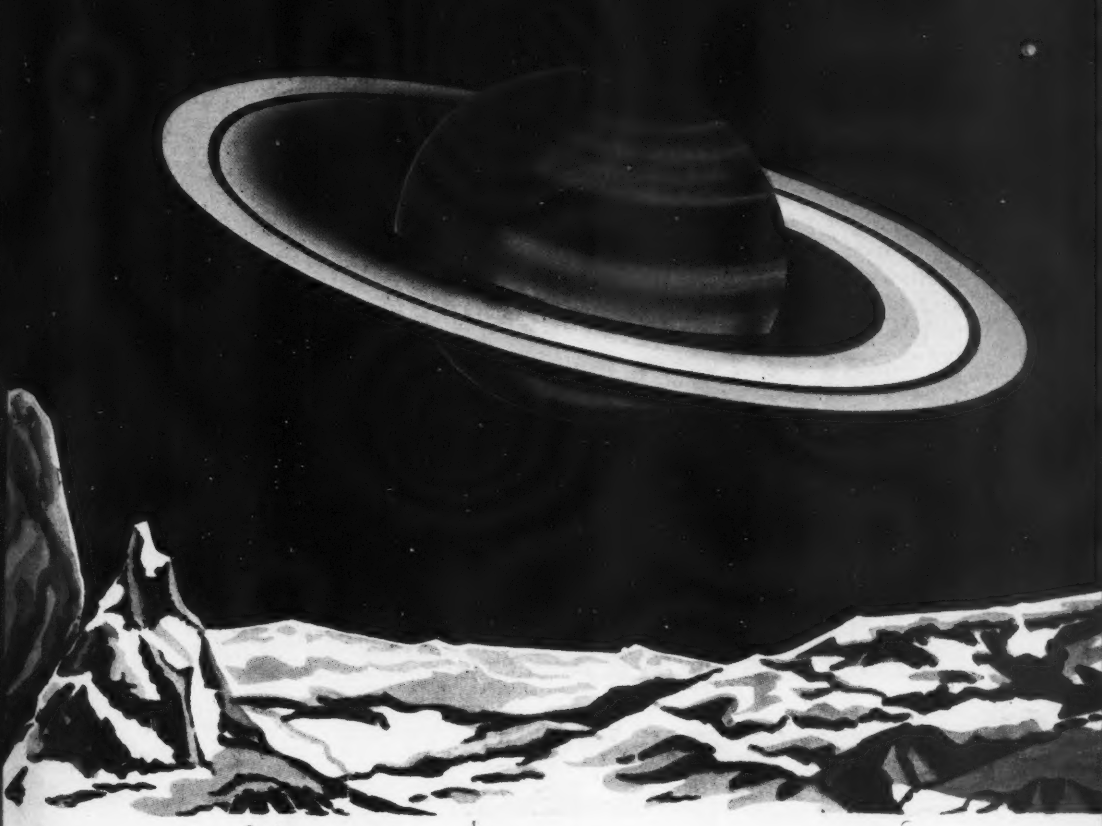

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A new model incorporating all welded steel frame, hand and foot operation, interchangeable notching head and cropper carrier, twin spindle 'down-holder' and even sturdier construction.

Angle and plate punching with solid die-to-floor support. Capacity—13/16″ dia. through 3/8″ or 11/16″ dia. through 1/2″.

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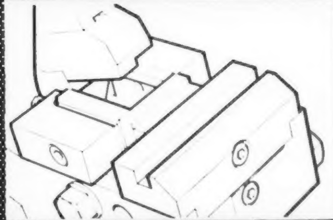
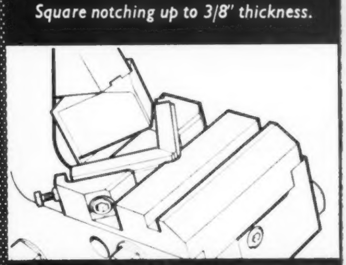
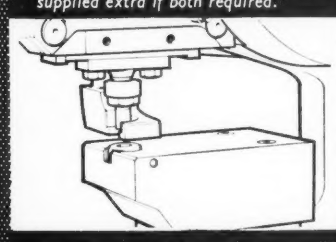


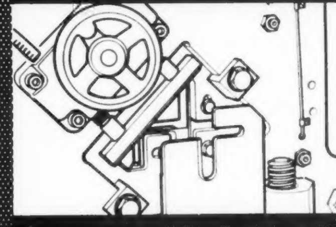
Square notching up to 3/8″ thickness.



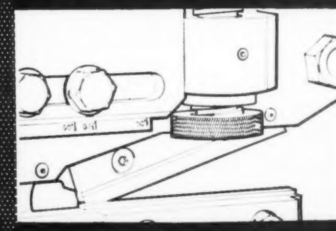
Mitre notching up to 5/16″ thickness. Alternative to square notcher or supplied extra if both required.



Optional die saddle for punching into flanges of joists and channels.



Cropping up to 3″ × 3″ × 3/8″ angles and tees.



Shearing up to 3/8″ thickness.

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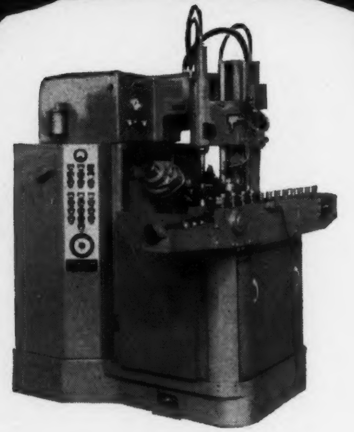
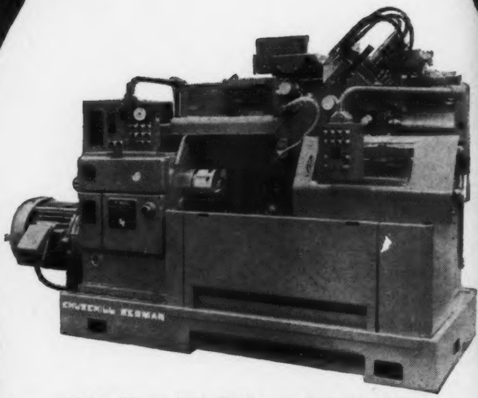
the most ECONOMICAL and POSITIVE power controls for machine tools



The Churchill S815 Rigidhobber

A complete VICKERS hydraulic system is used on this machine to control movements at a definite speed and in a positive manner. The system provides:

1 *Infeed and retraction at controlled rate to the hob head slide*
2 *Facilities for power tailstocks and tooling*
3 *Automatic loading devices*

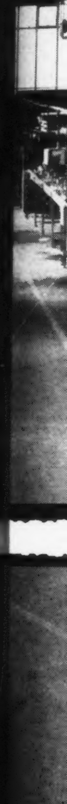


The Churchill Redman P.5 Profiling Lathe

This modern machine is fully hydraulically operated and electrically controlled by solenoid operated VICKERS valve units. The complete VICKERS hydraulic system provides:

1 *Power chucking and tailstock operation*
2 *Carriage movement with infinitely variable feed rates*
3 *Feed slide and other various machine movements with very flexible arrangement*
4 *Profile turning slide operation*
5 *Automatic loading*

The wide variety of duties which hydraulics can perform far better and at less cost than any other form of power, is well emphasised on a Link-Line of Churchill Profiling Lathes and Hobbing Machines where VICKERS Hydraulic Equipment is used throughout.



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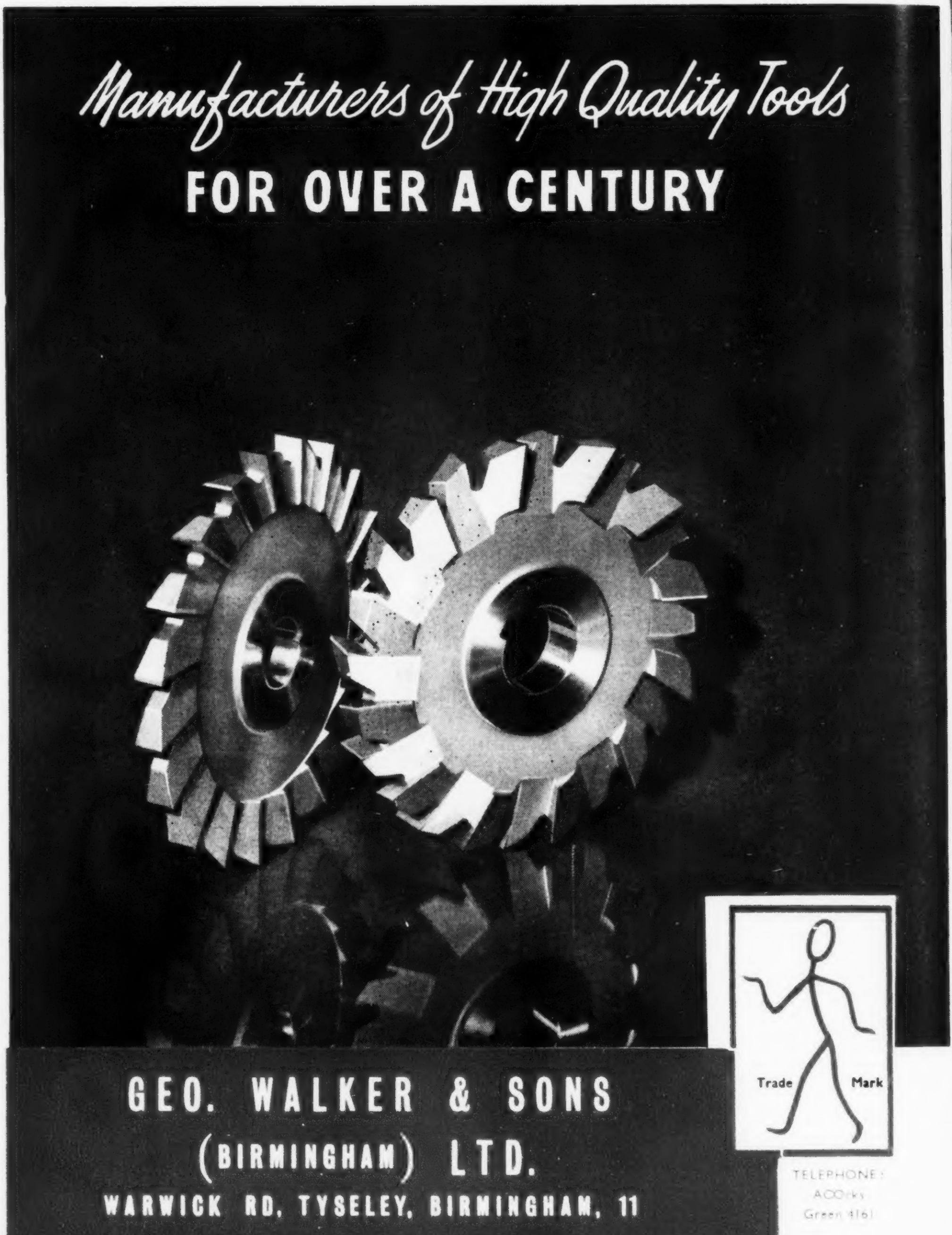
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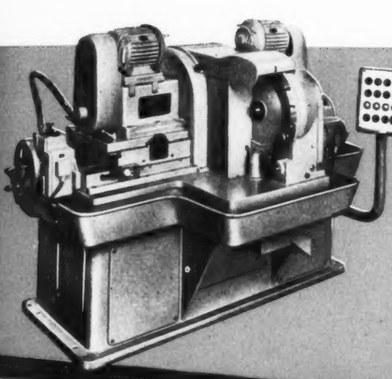
New Development

of Special Grinding Machines

for the manufacture of roller bearings



Duplex Rotary Surface Grinding Machine PPS

For the simultaneous grinding of faces on two parallel sides, i.e., levers, shifting forks, discs, cylindrical roller ends.

Main Data:

Grinding wheel dia.	$19\frac{11}{16}$in.
Speed of grinding wheel	85—91 ft./sec.
Angular position of grinding slide	5°
Revolutions of workholding drum	approx. 1 r.p.m.
Number of clamping positions	max. 40
Output with automatic loading	approx. 2,000/hour
Total power required	approx. 10.5 H.P.

Internal Cylindrical Grinding Machine SI 120

Application:

The machine is suitable for automatic grinding cylindrical or taper bores (both through and blind) as well as races and roller bearing rings.

Automatic control by:

- indirect sizing (diamond control)
- plug gauge control
- or electronic sizing control.

A combination of two sizing methods is possible.

A fully automatic cycle is obtained by using an automatic loading equipment.

Main Data:

Economic grinding range	1.6—4.7in.
Grinding depth max.	5.9in.
Taper angle to be ground up to	60°
Workpiece spindle with four speeds	180—1,080 r.p.m.
Grinding spindle speeds	6,000—15,000 r.p.m.
Grinding spindle dia.	4in.
Table speeds infinitely variable	0.3—33 ft./min.
Max. table stroke	18.5in.
Max. cross slide stroke (lifting)	0.4in.
Power required	10 H.P.

Karl Hüller GmbH.
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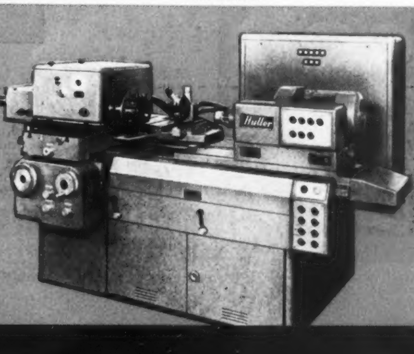

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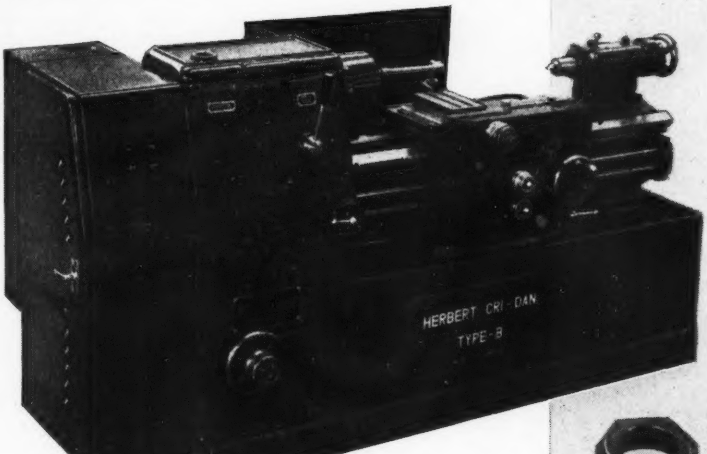
—the HERBERT/CRI-DAN *type B*

for high speed thread chasing

Provides the fastest method of cutting external or internal, single-or multi-start, up to 64, parallel or taper, up to 24° included angle, right- or left-hand, standard full, truncated or special thread forms in most materials. Cuts threads up to 5 t.p.i. in mild steel on 4" external and 6" internal diameters up to 3½" in length. Longer lengths are cut by resetting the saddle.

Can be fitted with Hydraulic Copy-turning Attachment; work up to 4" diameter by 12" long using either a template or model as a master, can be copy turned. The unit is self-contained.



- **Construction eliminates vibration.**
- **Pitch controlled by precision lead cam.**
- **Single-point tooling; carbide-tipped or high-speed steel.**
- **Thread depth positively controlled.**
- **Constant or diminishing feeds as required.**

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LATEST

DENISON VALVES

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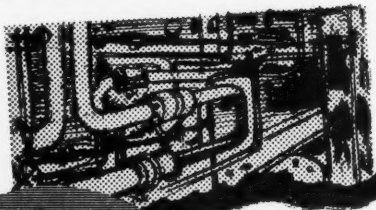

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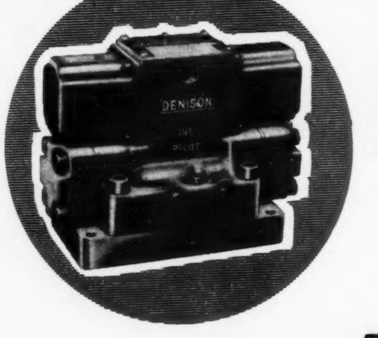
...normal conditions without replaceme...

Relief Valve
RV-061303A.
Weight 10.5 lb.
Cap 16.7 g.p.m.

Available now —

BRITISH-MADE DENISON ¾" RELIEF VALVES WITH :—

- Threaded bodies with BSP parallel threads.
- Subplate mounting type complete with subplates.
- Pressure control up to 5,000 p.s.i.
- Fast action eliminating over-pressures and pressure drops.
- Very low leakage rate.



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DID-063361CA.
Weight 30 lb.
Cap 25 g.p.m.

BRITISH-MADE DENISON, SOLENOID CONTROLLED, PILOT OPERATED ½" and ¾" 4-WAY VALVES WITH :—

- Five spool types.
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- Pilot adjustment choke pack.
- Oil-immersed solenoids.
- Subplates with BSP parallel threaded connections.

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GROUND THREAD TAPS
Made in chrome carbon steel, these taps meet the demand for more accurate and better finished threads so that the dimensions of mating parts are closely controlled to ensure interchangeable manufacture.
Most standard hand and machine nut taps stocked in all the generally-used sizes and thread forms.
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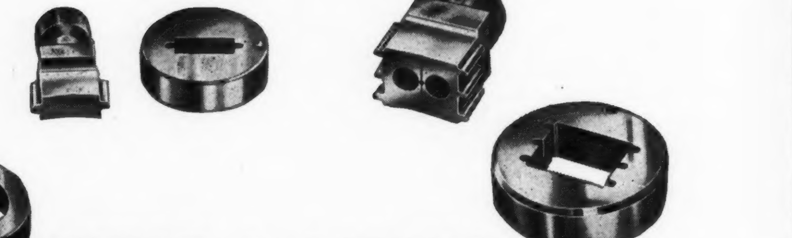

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HIGH SPEED HYDRAULIC PRESSES

Built solely for 'D & D' by Rhodes, Gill & Co. Ltd., specialists in high pressure hydraulics. Entire mechanism enclosed within sturdy fabricated steel frame. High ram speeds plus positive power return. Working pressure and slow advance for setting easily controlled. Pressure gauge and isolating valve provided. Compactly housed ram guides cannot foul pillars of die sets. Perspex guards available providing unobstructed view of entire table.

5 ton bench and pedestal models. 10 and 15 ton models available with stroke limiting device (provides extremely accurate "inching"), T-slotted tables and automatic rotary indexing table.

	5 TON	10 TON	15 TON
STROKE	4"	8"	10"
TABLE SIZE	14" x 11½"	16" x 14"	18" x 16"

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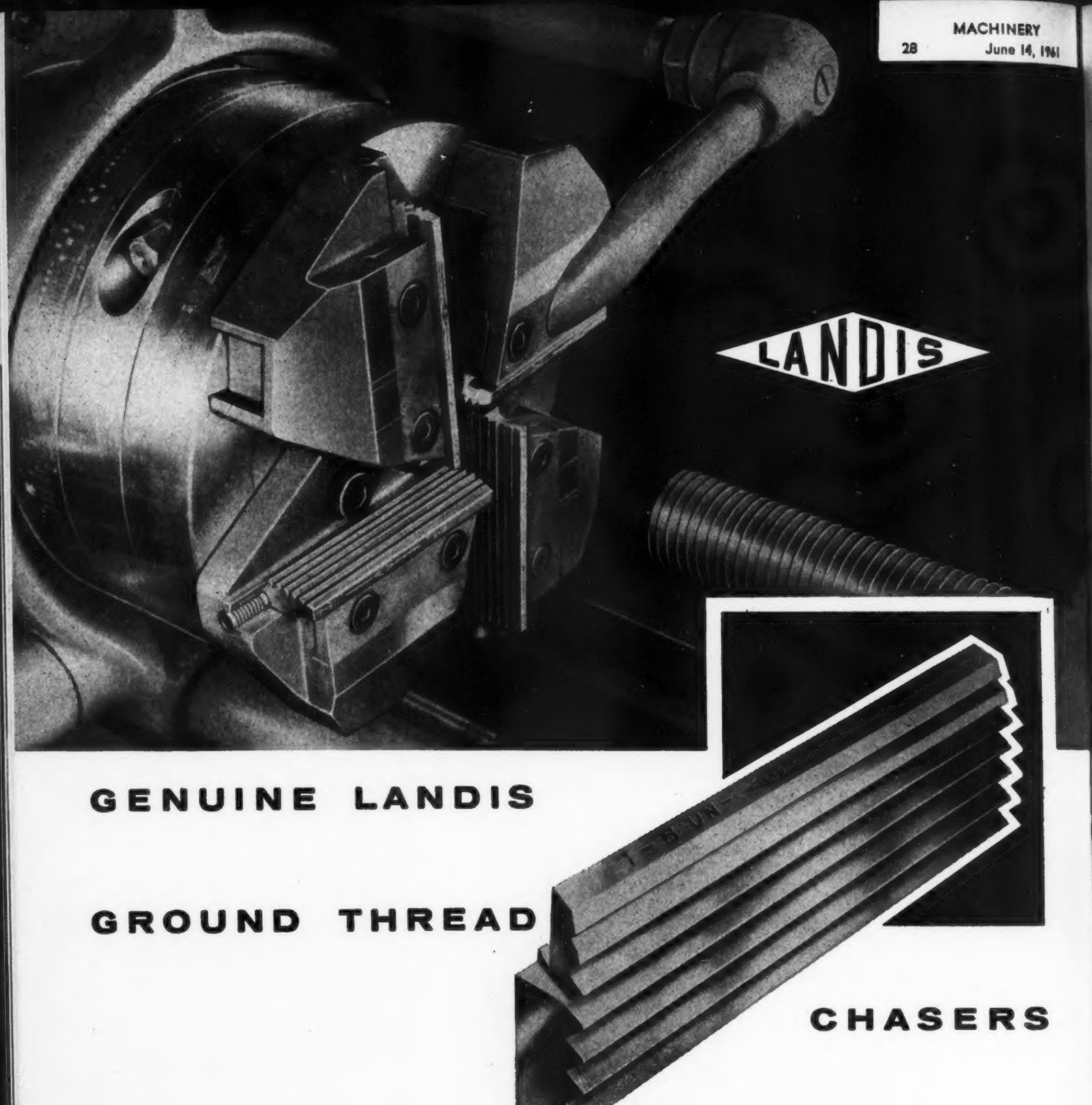
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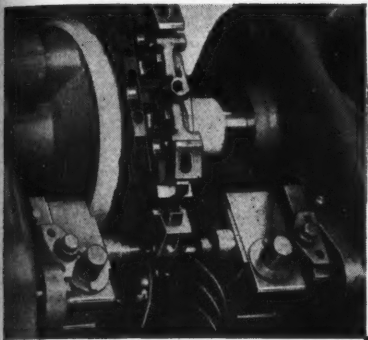

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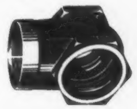

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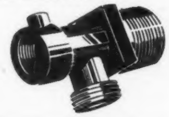

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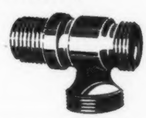

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It is significant that the Rover Co. Ltd., one of the manufacturers of Britain's finest cars, has chosen AJAX AJ31 Drills to assist in the production of their superb 3 litre car. They are used for jig drilling and spot facing engine sub-frames, apart from many other machining operations — once again AJAX RELIABILITY — predominates.

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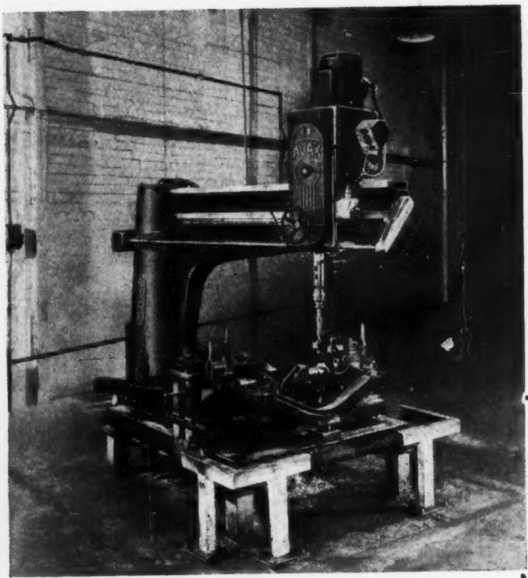

Photographs courtesy of The Rover Co. Ltd., Solihull, Birmingham.

to Ajax Machine Tool Co. Ltd., Halifax

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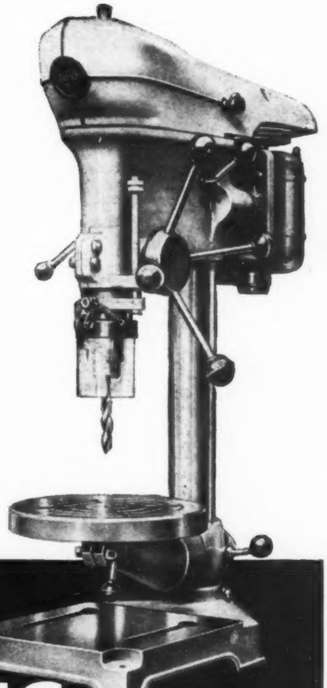

KERRY ¾ INCH CAPACITY SUPER "8" SPEED DRILL

A production and general purpose jobbing machine, robustly constructed to ensure absolute reliability under the most arduous operating conditions. Features that have made this Super "8" so popular include a wide speed range — from 86 to 3,360 r.p.m. or 45 to 2,000 r.p.m. and adaptability for such applications as drilling, reaming, tapping, lapping, trepanning, etc. Tens of thousands are in use throughout industry today. The Super "8" is available as a bench, pedestal or line production model together with a complete selection of attachments for special application.

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THE KERRY "DRILLMASTER"

A ½ inch capacity production drilling machine designed for continuous operation over long periods. The "Drillmaster" can be supplied with a low, standard, or high speed range to suit customers' requirements. Each model has 4 spindle speeds ranging — in the low speed machine from 300 to 2,200 r.p.m. — the standard from 617 to 3,360 r.p.m., and the high speed machine up to 7,000 r.p.m. Bench, pillar and line production models are available in the above speed ranges.

KERRY'S

manufactured within the KERRY GROUP by
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A Kerry COMPANY

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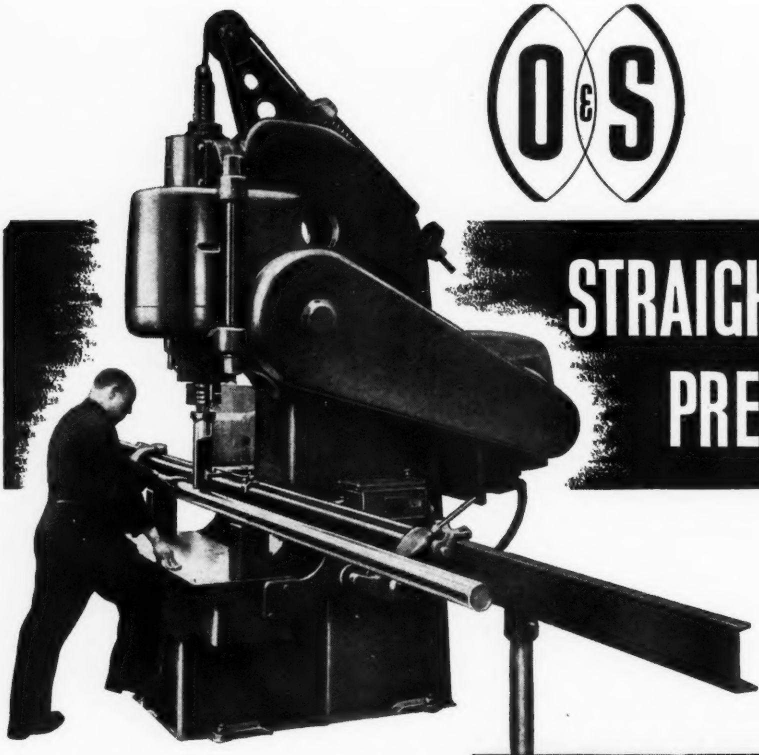
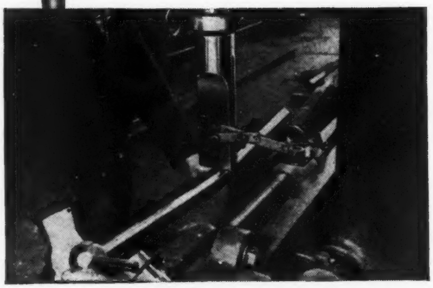
O&S

STRAIGHTENING PRESSES





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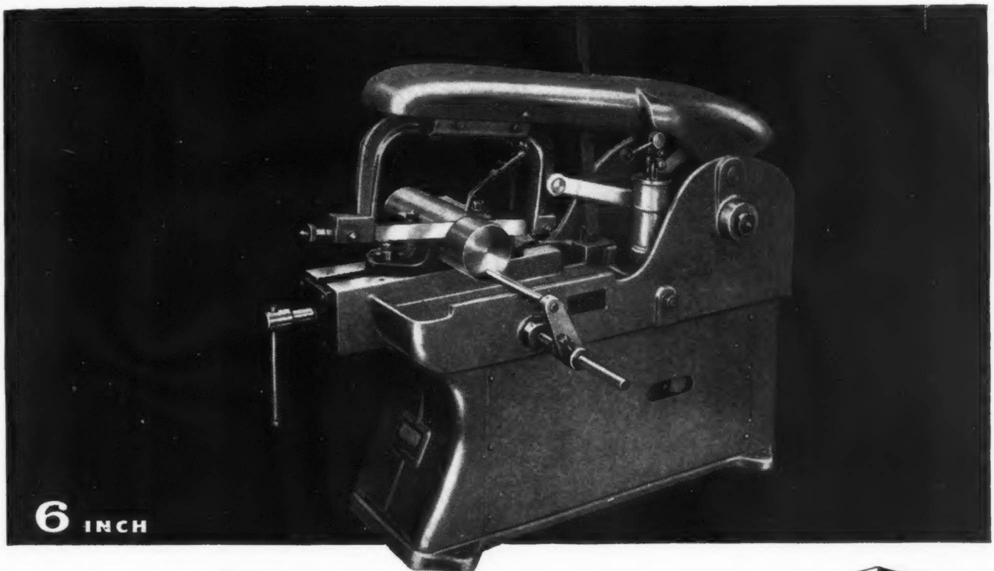

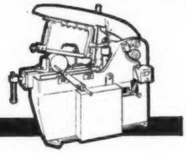

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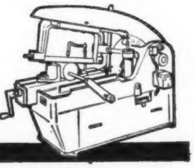

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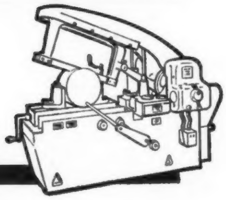

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Modern in design, robust and precise in construction, these unrivalled machine saws cut accurately and rapidly, and offer maximum production efficiency. Refinements include totally enclosed drive, hydraulic relief on the return stroke and automatic lifting of the bowslide to loading position on completion of cut.

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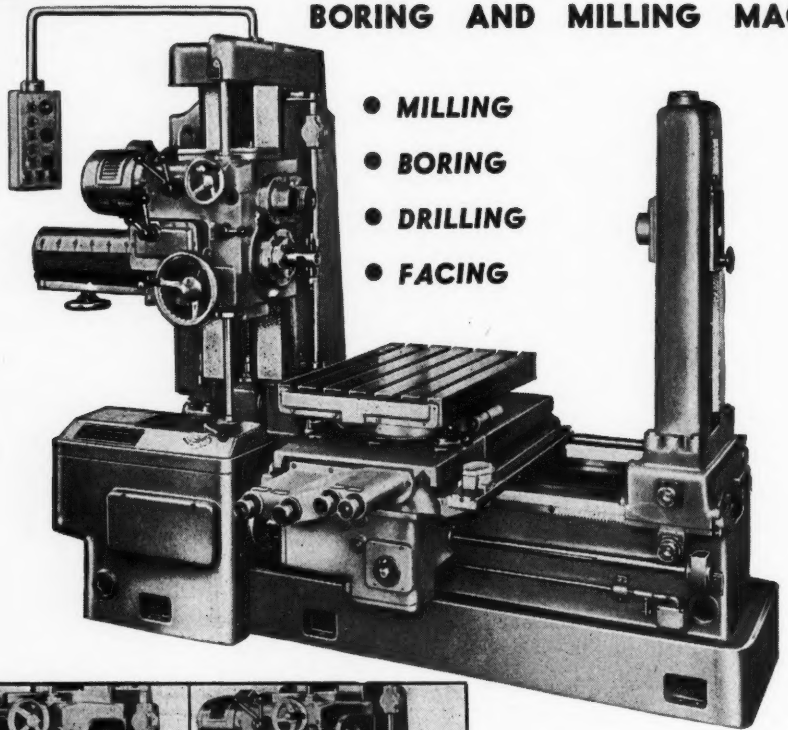
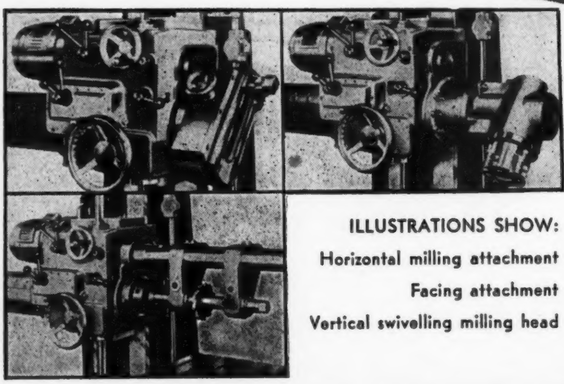
GATE LA.60 *Multi-Purpose*

BORING AND MILLING MACHINE



- ***MILLING***
- ***BORING***
- ***DRILLING***
- ***FACING***



ILLUSTRATIONS SHOW:
Horizontal milling attachment
Facing attachment
Vertical swivelling milling head

Spindle diameter $2\frac{3}{8}$"

Table $31\frac{1}{2}$" x 21"

Maximum traverses: longitudinal 30". cross 30", vertical $19\frac{3}{4}$"

Spindle speeds (12) 28-1300 r.p.m.

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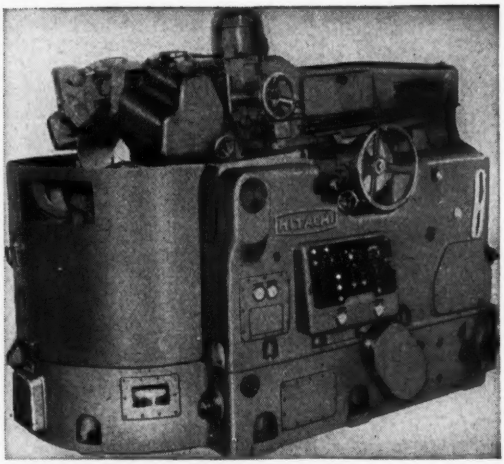
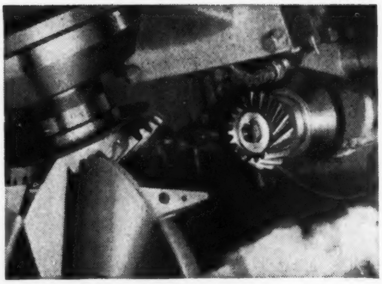
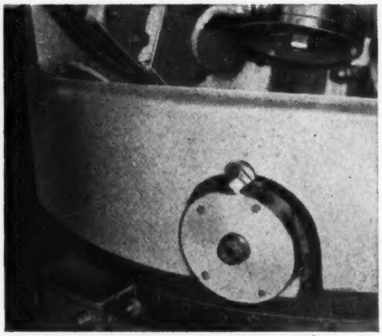
Efficiency *plus* HITACHI Bevel Gear Grinder



HITACHI Bevel Gear Grinder Type 600 BG-1



WORK HEAD
The photo shows that a set of gear and pinion is fitted on each work head.



DIAL FOR AUTOMATIC SETTING
The table constructed in the two-stage type, and is provided with a screw for parallel slide and a dial.

Characteristics:

The HITACHI bevel gear grinder, Type 600 BG-1, has been designed on an entirely new principle of generating method, and is credited with the following features:—

1. **The machine can be operated with utmost ease.**
2. **Crowning is possible even in the direction of gear teeth.**
3. **The same grinding wheel can be used irrespective of dimensions, helix angles, pressure angles of the bevel gears to be processed.**
4. **Meshing tests can be conducted without removing the processed gear.**

Specifications:

Max. pitch dia.	610 mm.
Min. pitch dia.	50 mm.
Largest cone distance	305 mm.
Pressure angle	14½°—20°
Max. helix angle	35°
Module	2·5M—8M
Dia. of grinding wheel	400 mm.
Main Motor	5 h.p.
Size of Machine	2,765 mm. x 2,000 mm. x 1,850 mm.
Net Weight	approx. 11,00 kg.

Patents on this grinder:—

Patents have been applied for in the United States, Britain, Germany Switzerland and Italy, in addition to those already taken out in Japan.

Other HITACHI products include:—

Gear hobbing machines
Knee-type milling machines
Surface grinders
Roll lathes and grinders
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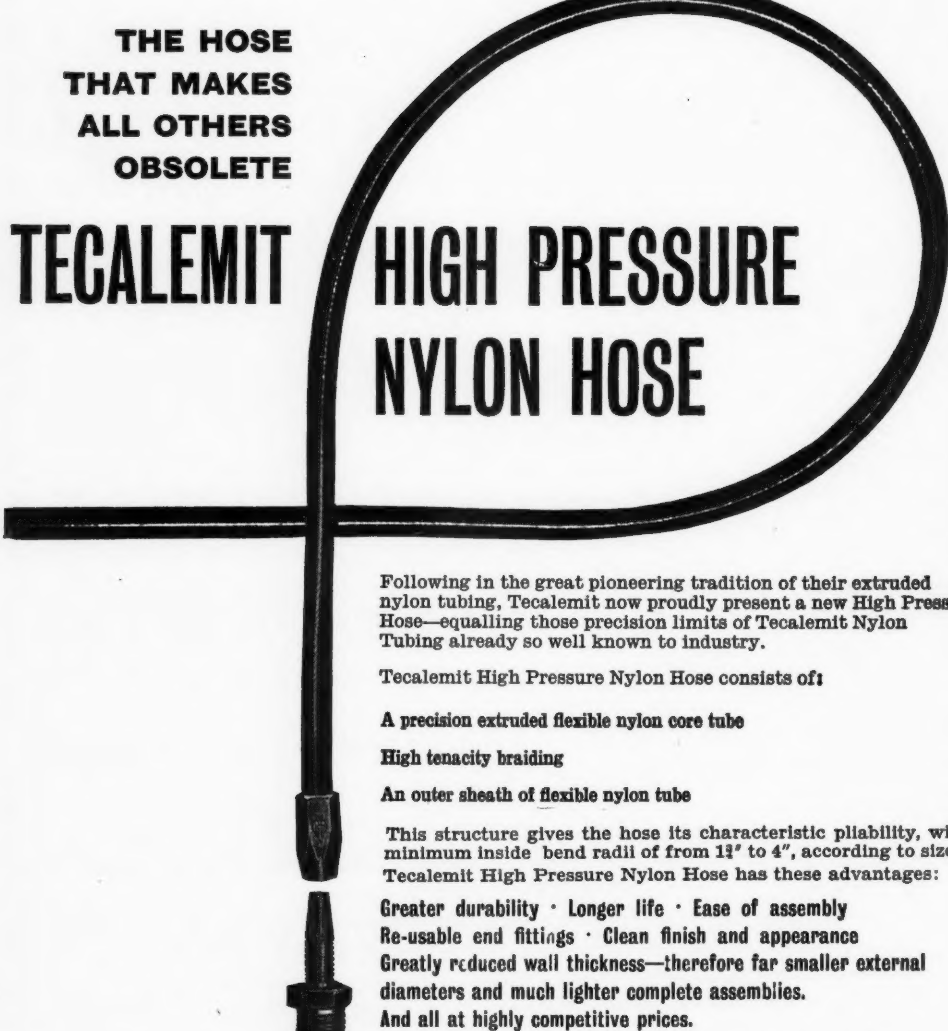

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Tecalemit High Pressure Nylon Hose consists of:

A precision extruded flexible nylon core tube

High tenacity braiding

An outer sheath of flexible nylon tube

This structure gives the hose its characteristic pliability, with minimum inside bend radii of from $1\frac{3}{4}''$ to 4", according to size. Tecalemit High Pressure Nylon Hose has these advantages:

Greater durability · Longer life · Ease of assembly
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Greatly reduced wall thickness—therefore far smaller external diameters and much lighter complete assemblies.
And all at highly competitive prices.

If you wish to substantiate these claims, Tecalemit will provide sample standard lengths of hose assembled with common forms of coupling, so that test rigs can be undertaken. Tecalemit High Pressure Hose is supplied in five sizes $\frac{1}{8}''$, $\frac{3}{16}''$, $\frac{1}{4}''$, $\frac{3}{8}''$ and $\frac{1}{2}''$ internal diameter, to meet the needs of industry for hydraulic and pneumatic systems. Write for full technical details of Tecalemit High Pressure Nylon Hoses and their use on hydraulic and pneumatic systems for:—

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This new S.S. and S.C. Lathe is built to Monarch's usual exacting standards and incorporates many features usually found only on larger machines. The in-built accuracy of this Lathe coupled with its robust construction makes it ideal for both toolroom and production work.

Each feature of the machine has been proved in the field and is based on Monarch's 50 years' experience in building precision lathes.

ACCURACY • ECONOMY • LONG LIFE •

* Flame hardened and ground bed ways
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* All-geared headstock with constant mesh helical gears
* Automatic lubrication systems

BRIEF SPECIFICATION

Height of centres	8″
Distance between centres ..	54″
Swing over cross slide	10″
Spindle speeds (16)	28—1200 r.p.m.
Feeds (48)	0.0012—0.070 ins/rev
Thread range	$1\frac{1}{2}$—92 t.p.i.
Motor	5 h.p.

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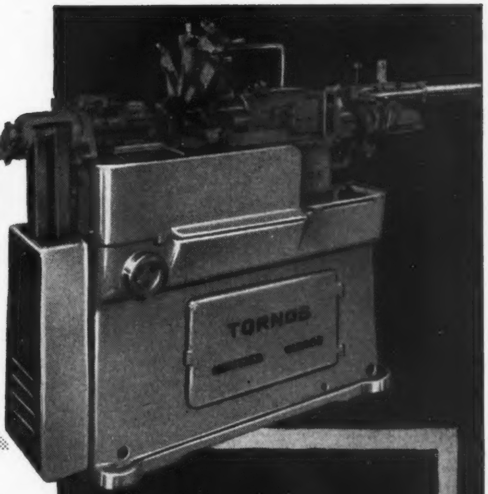

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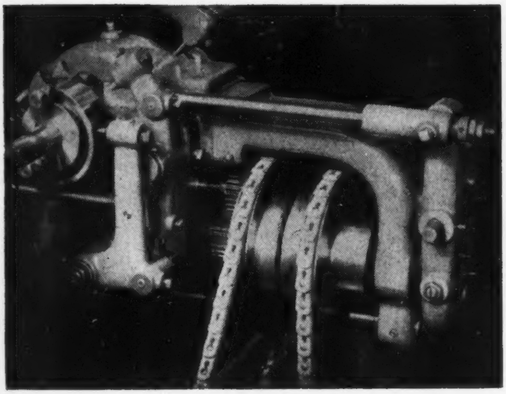

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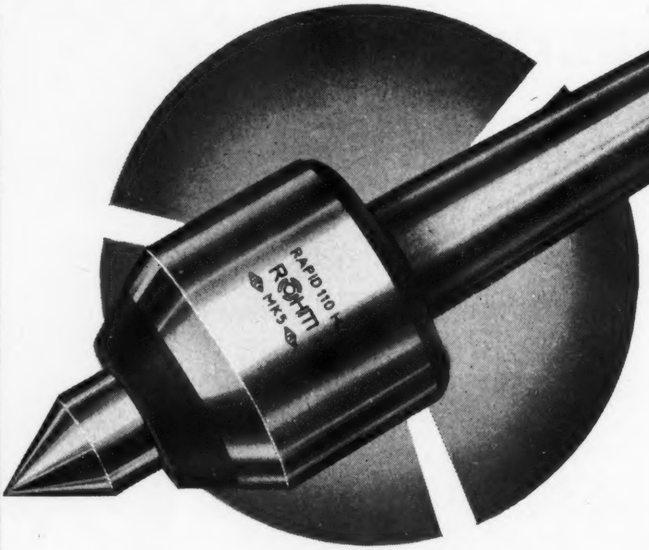

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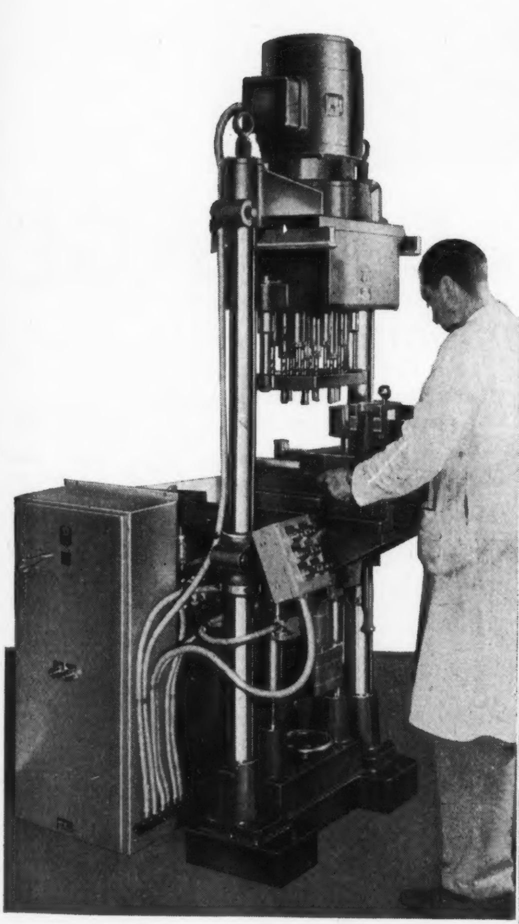
Hydraulic Multi-spindle drilling machines



These hydraulic up-stroking multi-spindle drilling machines provide fast approach, accurately controlled drilling feed and fast return of the worktable after completion of drilling. They are extremely flexible in use and can be fitted with driving motors of up to 15 h.p. — the thrust available from standard machines can be varied up to 8,000 lbs.

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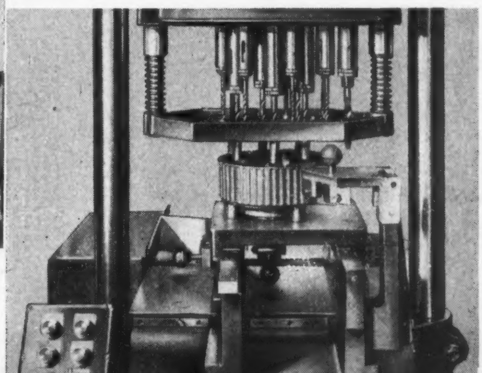

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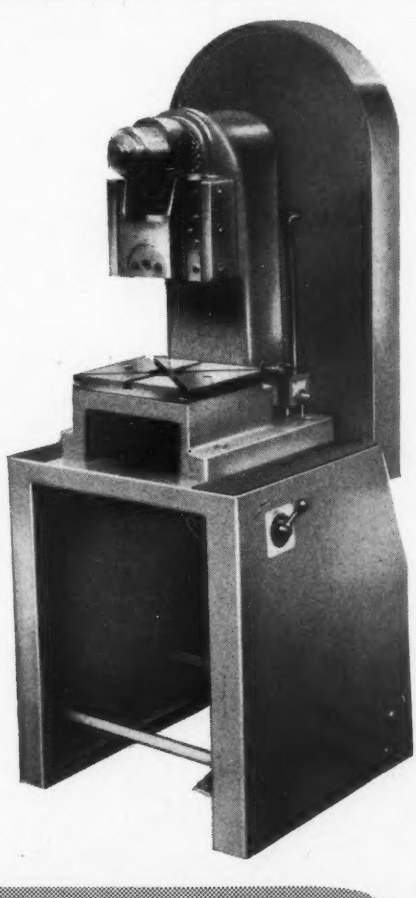

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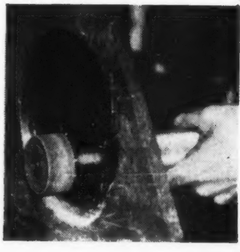

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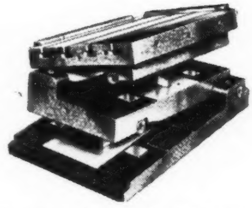
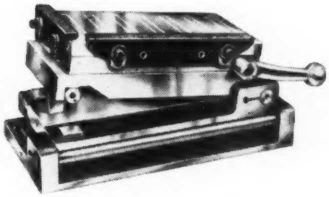
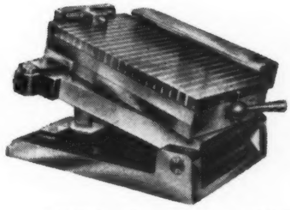


Compound Sine Table with 'T' Slotted Face: 12in. by 8in.



Compound Sine Table with Non-Electric Magnetic Face: 10in. by 5in.



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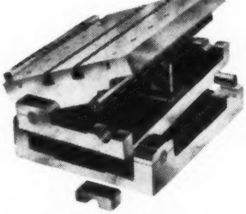

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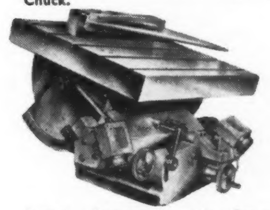

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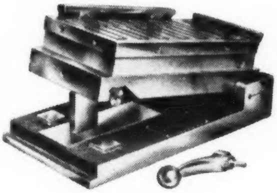
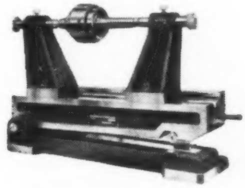


Simple Angle Sine Table with Non-Electric Magnetic Face: 10in. by 5in.



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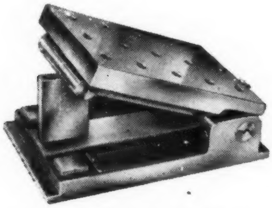

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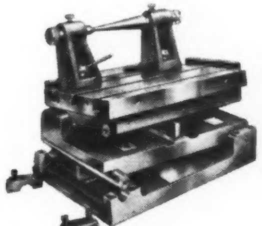

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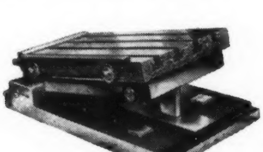

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Universal Compound Sine Table with Non-Electric Magnetic Chuck: 12in. by 8in.

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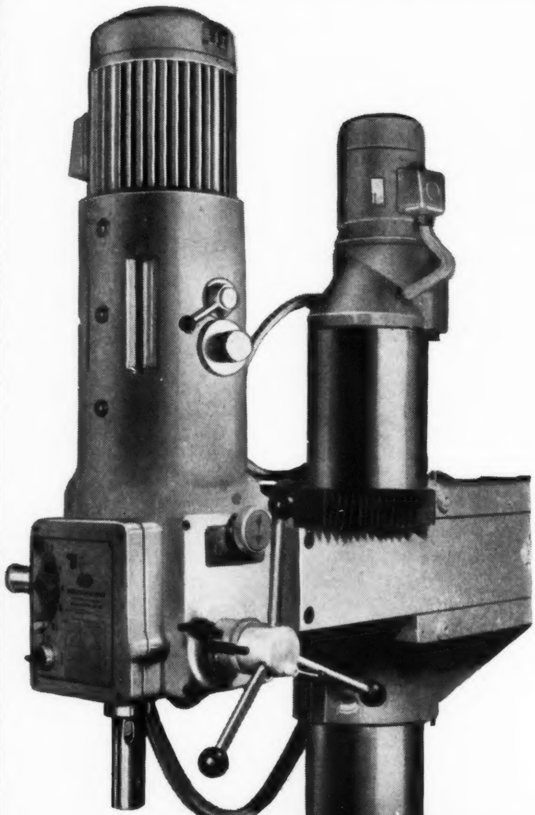

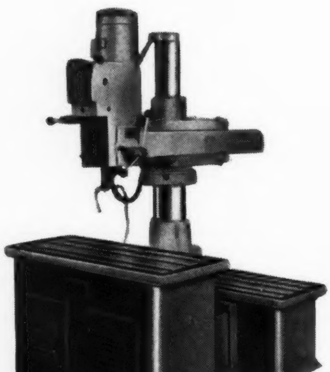

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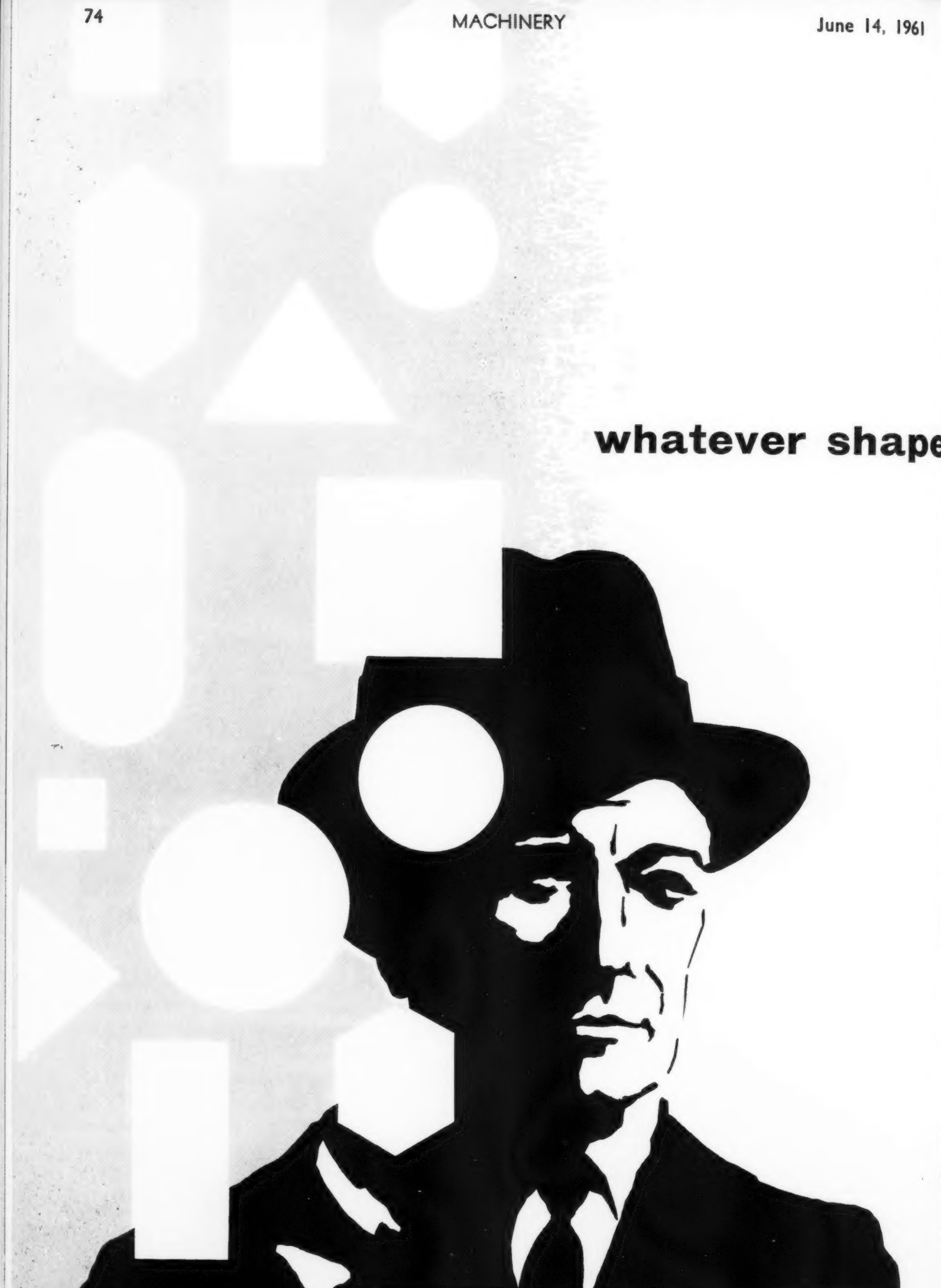
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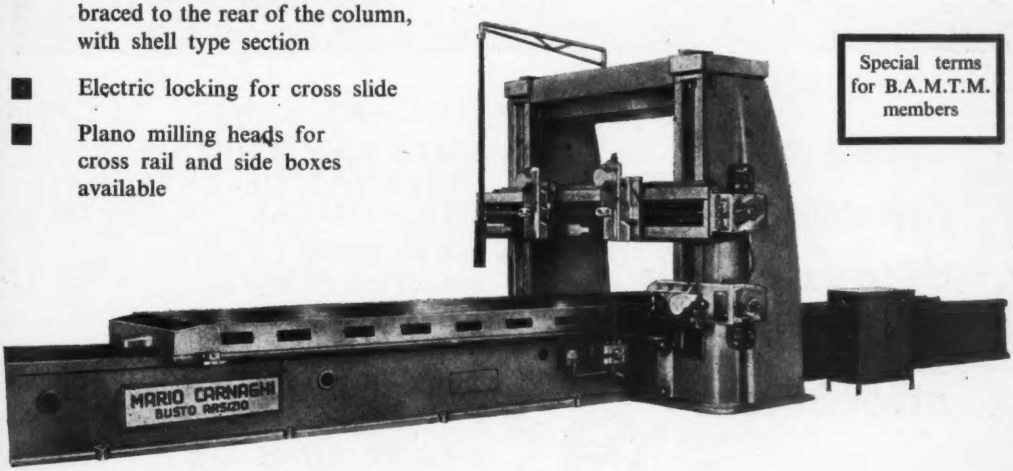

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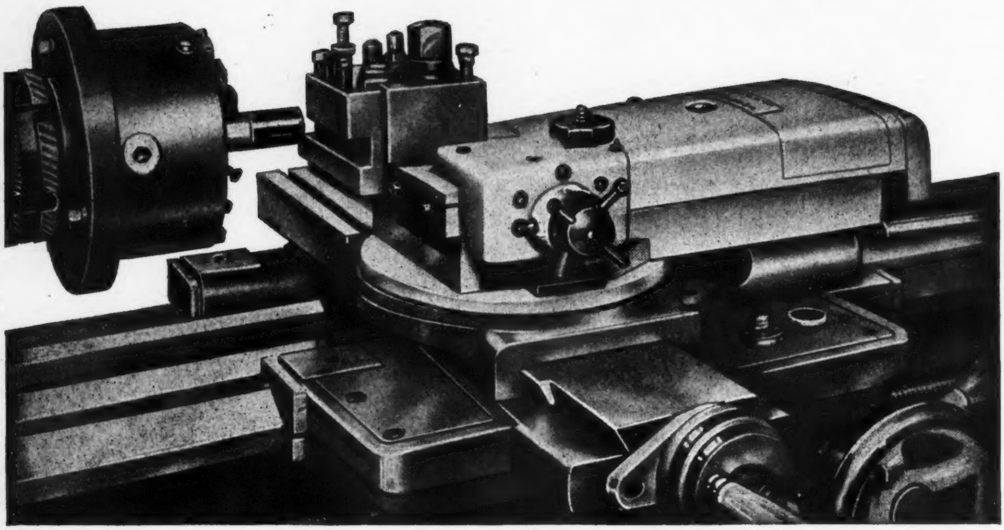

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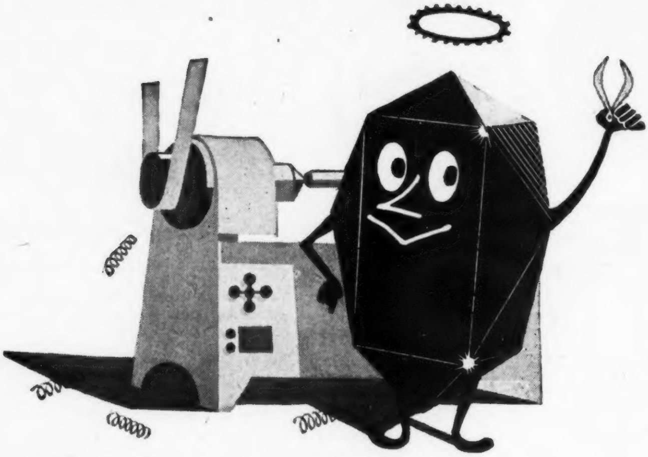

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Modern grading and washing methods ensure that coal is the most efficient and consistent fuel for every type of boiler—the ideal fuel for every section of the light engineering industry. But to obtain the maximum heat at the lowest cost, coal should be mechanically stoked. A mechanical stoker automatically feeds the right amount of coal for the boiler load even when the load is varying; it burns coal at optimum efficiency all the time without the emission of smoke (thus complying with the regulations in Smoke Control Areas) and it virtually replaces the human element in boiler operation.

There are many types of mechanical stokers, of which the most commonly used are the Chain Grate stoker, the Coking stoker, the Underfeed stoker and the Sprinkler stoker. Standard models are available for all sizes of boiler.

Two underfeed stokers feeding coal direct from a storage hopper into a modern vertical boiler.

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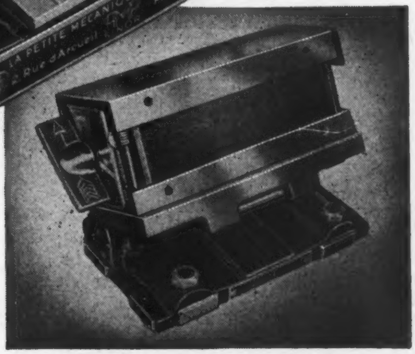

The table is dimensioned to accept the Eclipse Double Sided Junior Magnetic Chuck.

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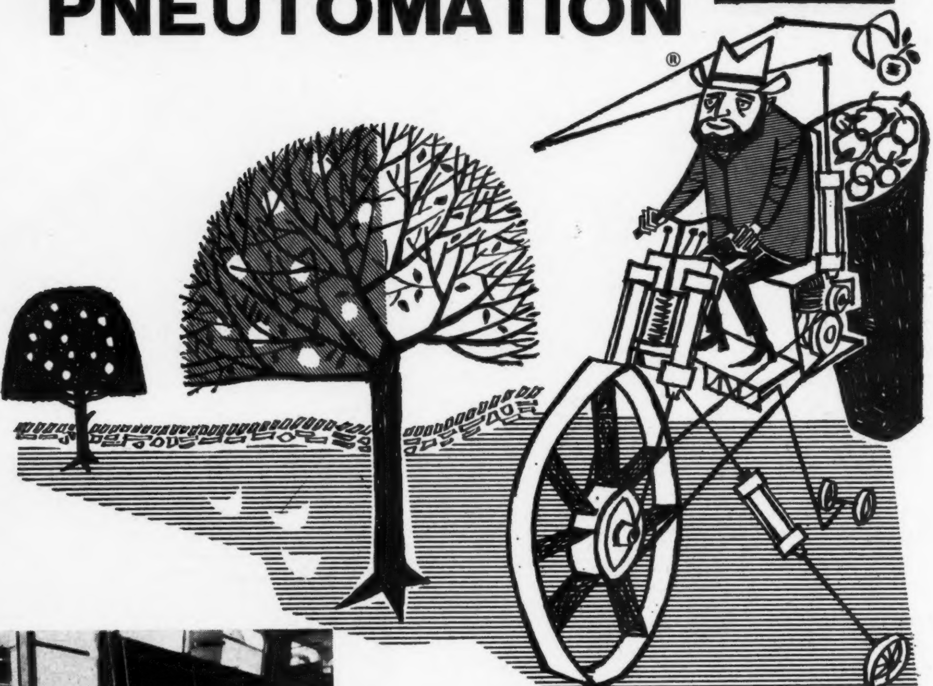

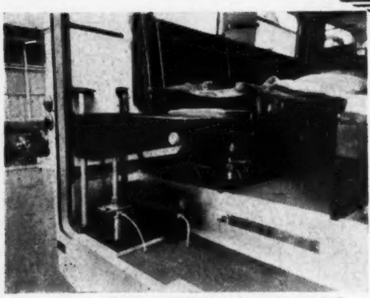

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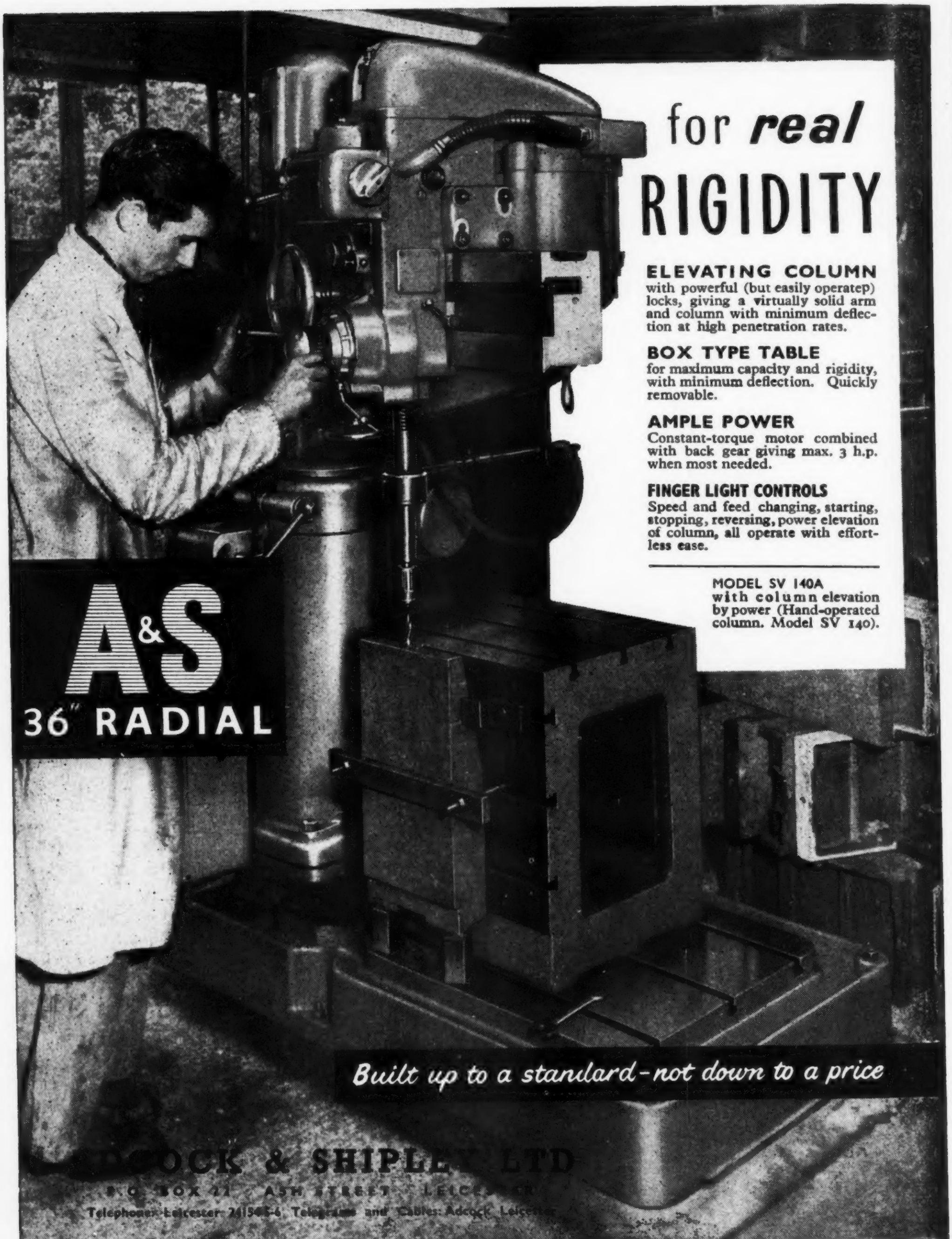
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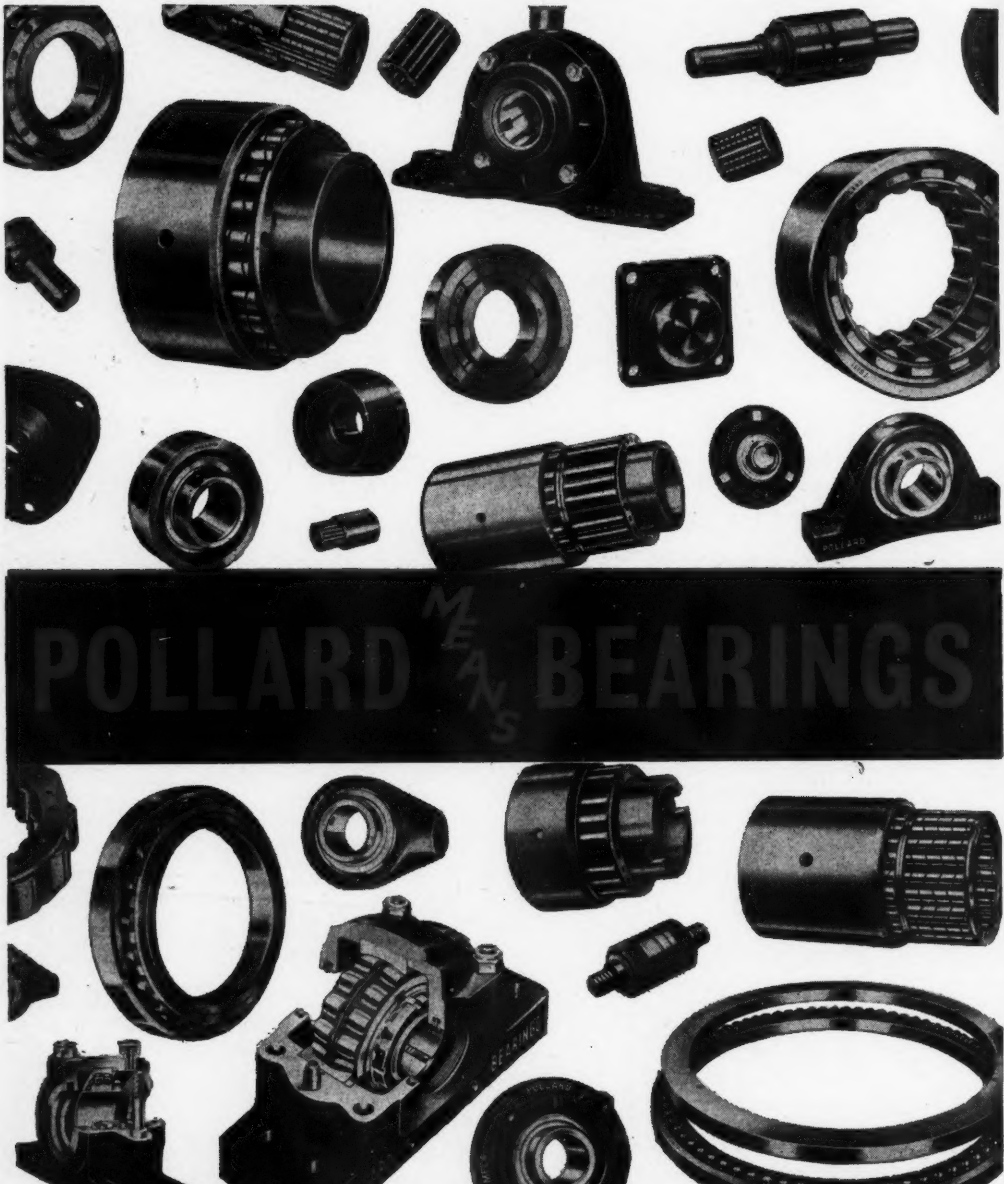
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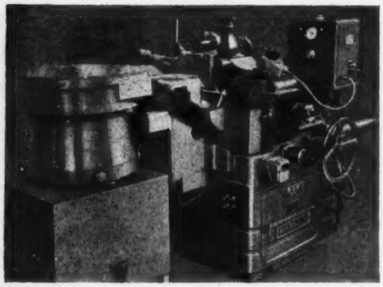
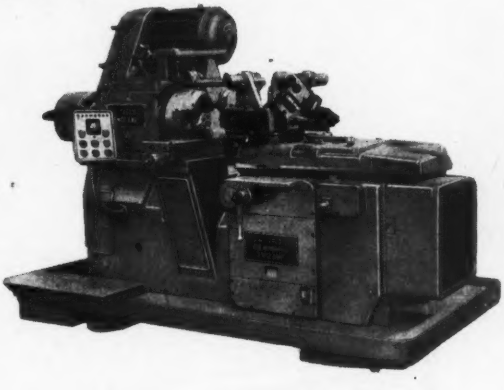
B.S.A. ACME-GRIDLEY $\frac{5}{8}$" six-spindle automatic bar machine. Designed for high spindle speeds and fast cycle times combined with accuracy and good surface finish. Machine has two position feeding and stock can be fed during index. The main toolslide is provided with end adjustment to assist setting up for components of similar design but of varying length. Collet capacity $\frac{5}{8}$" dia. Length fed and turned 4". Speeds 4,340 to 321 r.p.m. Motor 15 h.p.

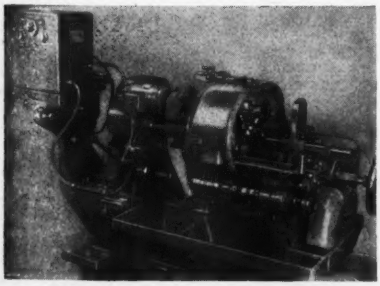
B.S.A. 5M single-spindle chucking automatic linked to a B.S.A. ACME-GRIDLEY 6" six-spindle chucking automatic. After first operation machining the component is conveyed via the overhead chute to the multi-spindle machine for completion. Chucking is electro pneumatic.



B.S.A. No. 4 centreless grinding machine with automatic sizing control and automatic infeed. In this set-up special bolts $\frac{7}{16}$" x $2\frac{7}{8}$", fed from vibratory type hopper, are ground to a tolerance of 0.0005" ; 700 per hour.



B.S.A. No. 95 All-Electric single-spindle automatic chucking machine with "DISCOTROL" programme control unit. (Complete machining programme for a component recorded on a master disc). Immediate changeover effected by substituting a new programme disc and appropriate tooling. Re-setting of machine speeds and feeds eliminated. Highly sensitive overload device protects tooling. Five-face turret. Swing over cross slides $10\frac{3}{4}$" (maximum swing $12\frac{1}{2}$"). Stroke: of cross slides 4", of turret $5\frac{3}{4}$". Thirty spindle speeds: 40 to 834 or 60 to 1220 r.p.m.



B.S.A. No. 48 single-spindle automatic screw machine arranged for automatic inspection of 0.0150" hole through component. Obstruction to an air blast through the hole causes a back pressure to be fed to a control which stops the machine.

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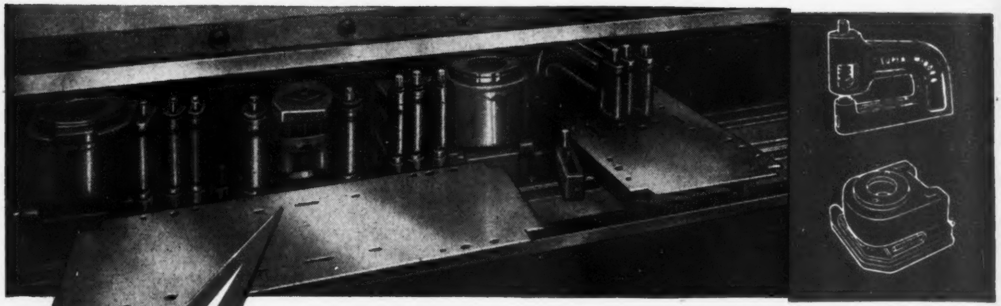

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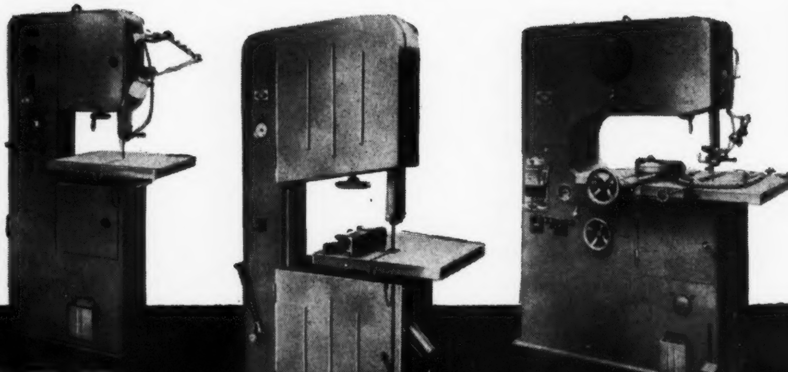

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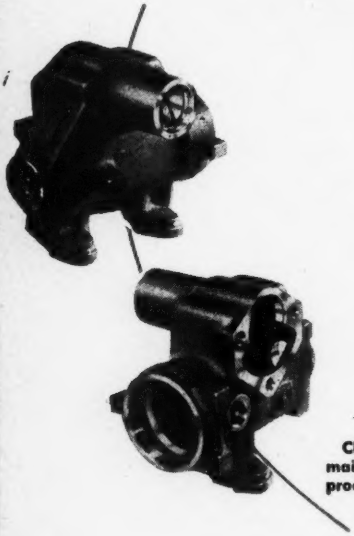

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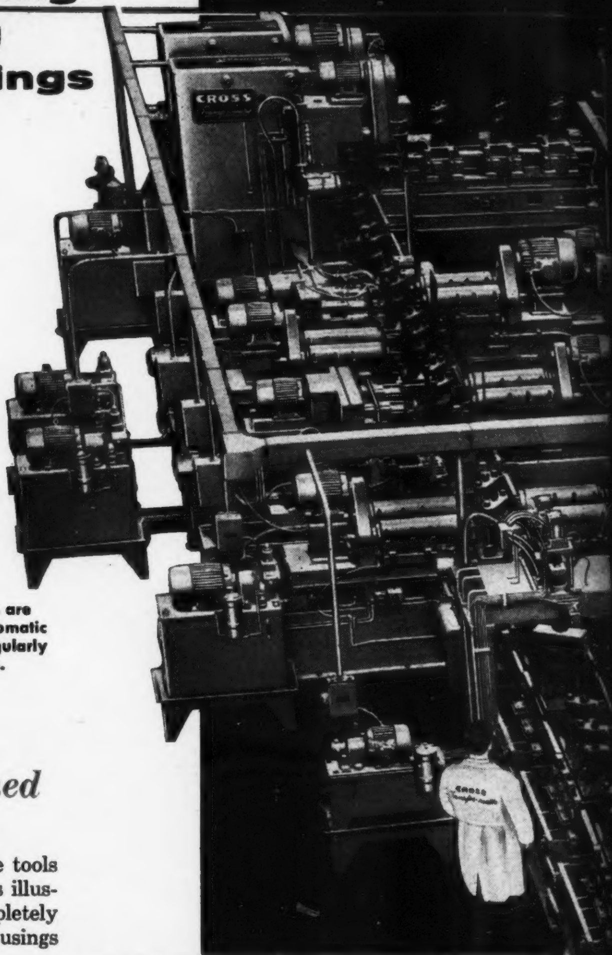


New Transfer-matic Designed to Prevent Obsolescence

A typical example of how transfer type machine tools can be designed to guard against obsolescence is illustrated by this new Cross Transfer-matic. It completely machines and assembles power steering gear housings except for the mounting feet.

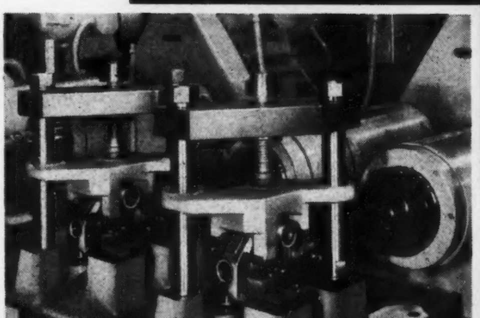
Useful life has been materially increased by building the Transfer-matic to process housings with longer pitman shaft extensions than those now being produced. Three idle stations permit other operations to be added and the use of standard Cross "building blocks" provides further flexibility for part design changes.

Present operations include milling, drilling, boring, counterboring, spot facing, chamfering, tapping, deburring, and assembling the worm thrust bearing cups and the pitman shaft bushings in the housings. Rated production is 300 pieces per hour.

A special feature is the provision for off-line inspection of the pallets and the parts without loss of production.

Another feature is the provision for in-line inspection at three different stations and final inspection just before the assembly operations.

If you would like to know more about these and other Cross innovations, just drop us a line.



Precision boring of the worm shaft hole—two at a time.


Another Transfer-matic by Cross
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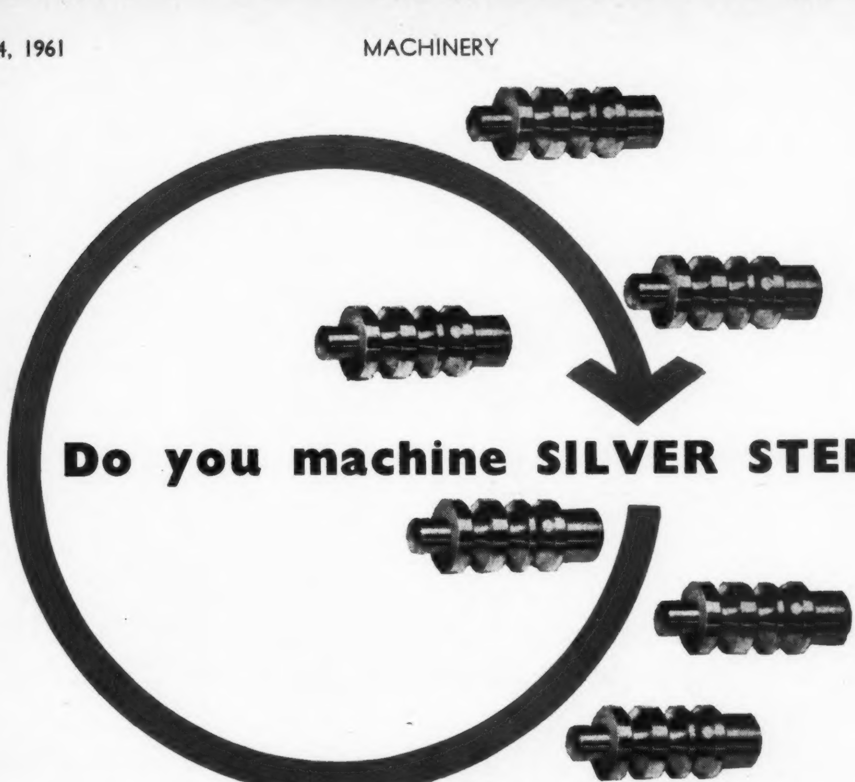
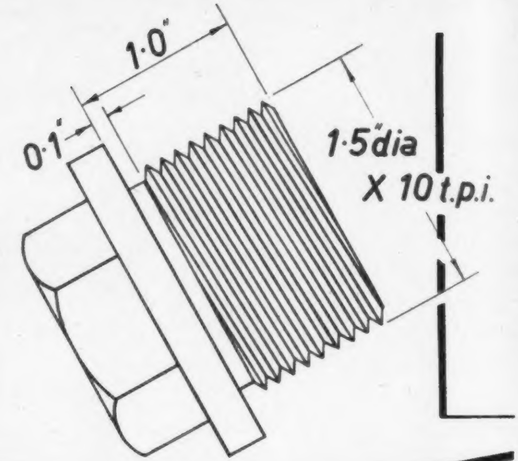


Could you screwcut this 'Nimonic 80' component in 25 secs. on a centre lathe?

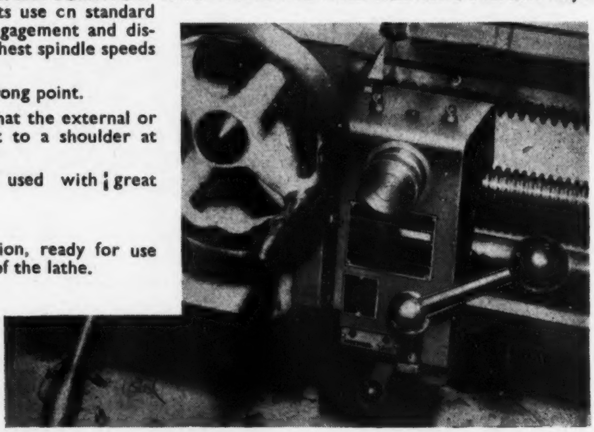


The answer is 'yes' if you fit an 'AINJEST' high speed screwcutting attachment!

For 1 off and upwards
Toolroom or Production — setting time is negligible.

In the same way that the chasing dial has superseded the old method of marking chuck, headstock, leadscrew collar and bracket; the AINJEST HIGH SPEED SCREWCUTTING ATTACHMENT has established a further major advance in screwcutting techniques. Its use on standard centre lathes allows the automatic engagement and disengagement of the leadscrew at the highest spindle speeds of which the machine is capable.

- ★ The cut cannot be started at the wrong point.
- ★ The cut is stopped accurately so that the external or internal threads can be cut tight to a shoulder at high speeds.
- ★ Tungsten carbide tools can be used with great advantage.
- ★ Chasing dial is eliminated.
- ★ The attachment remains in position, ready for use without restricting the versatility of the lathe.



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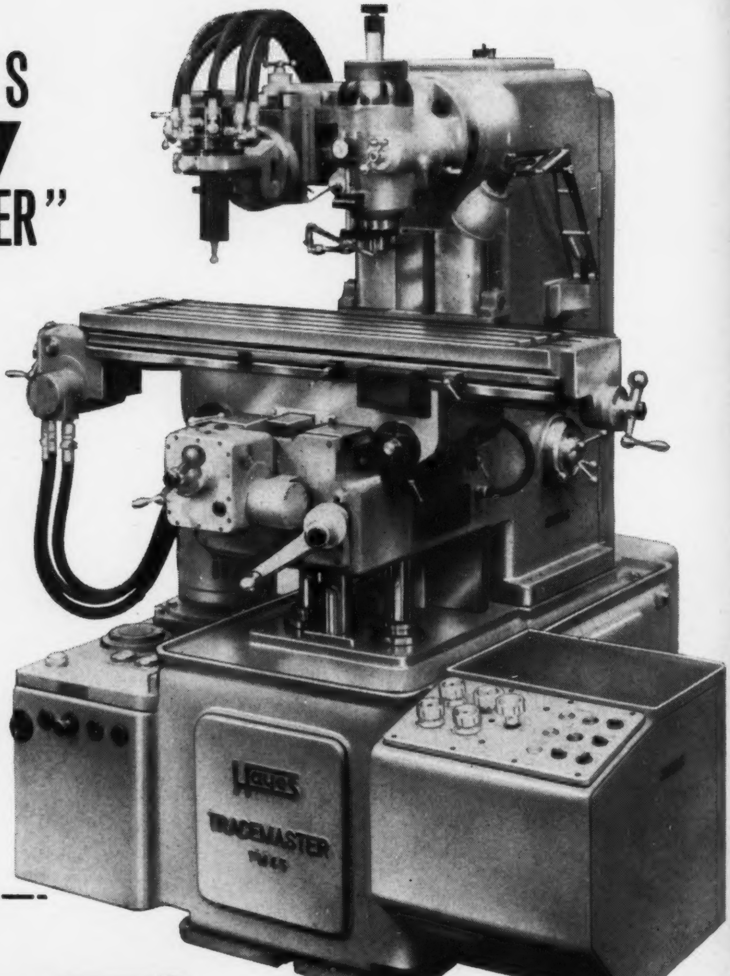

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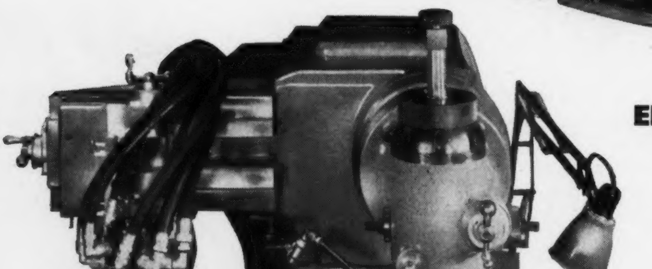

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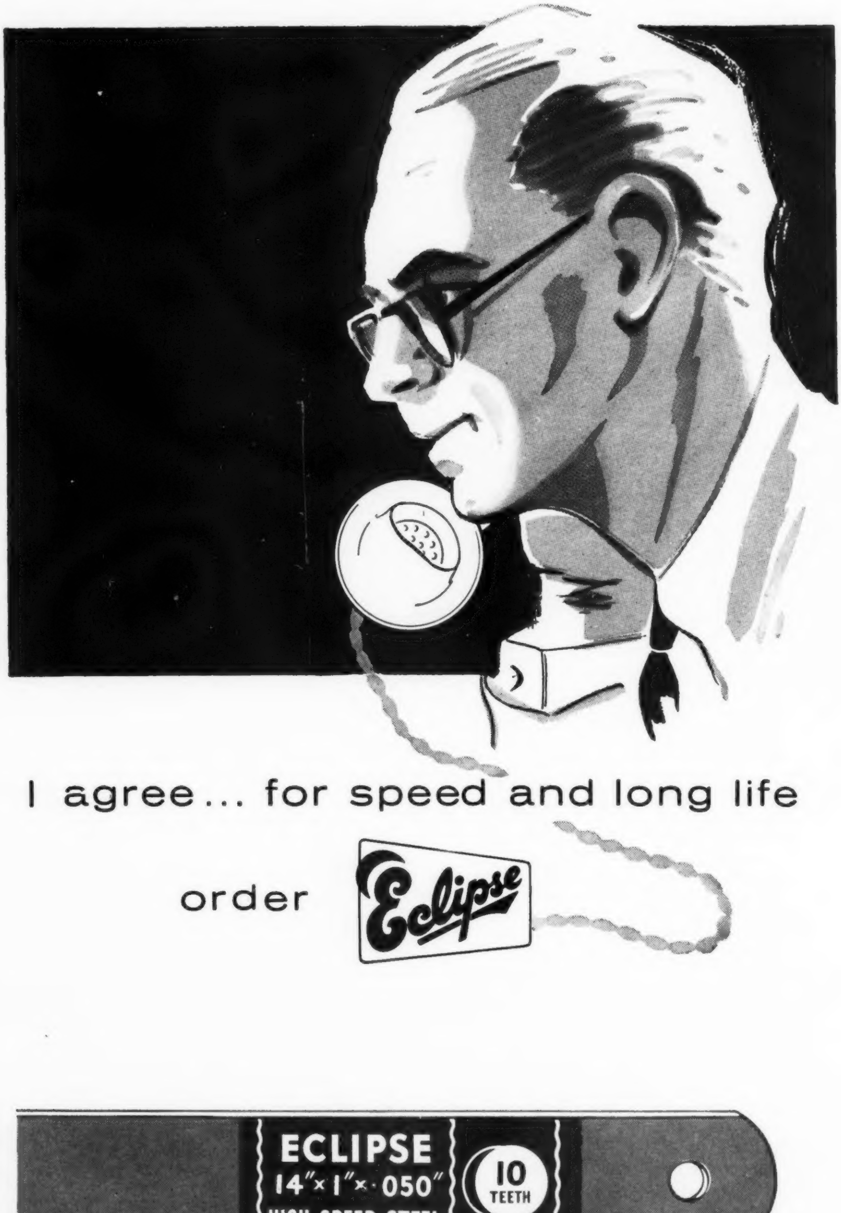

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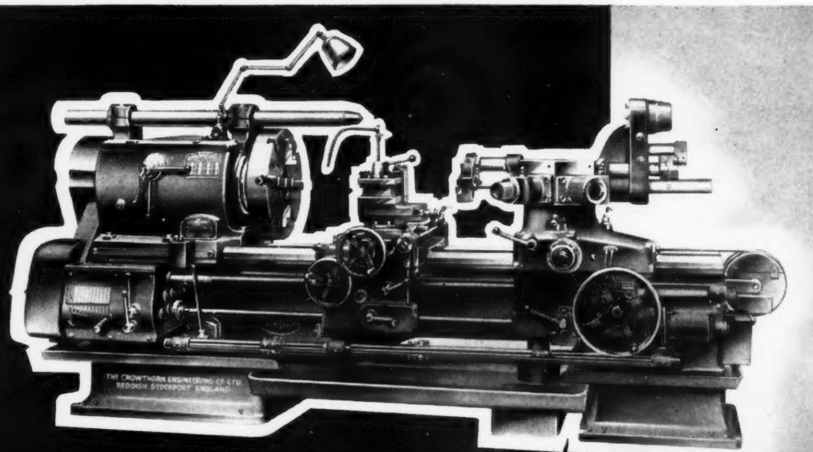

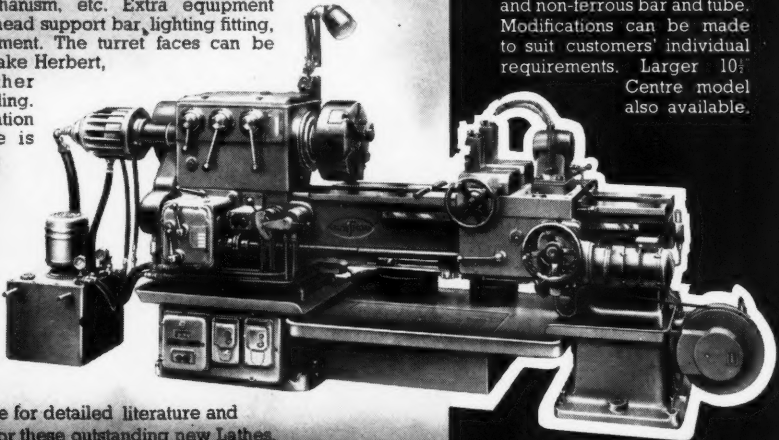

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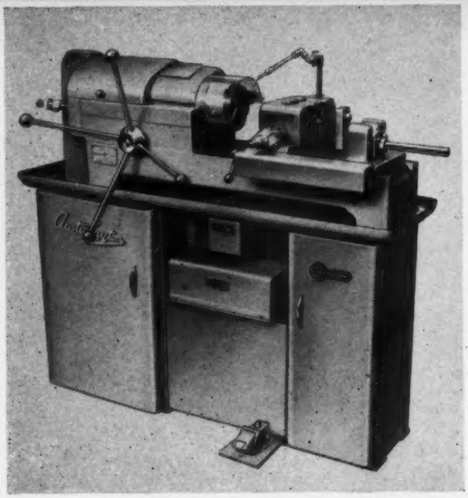
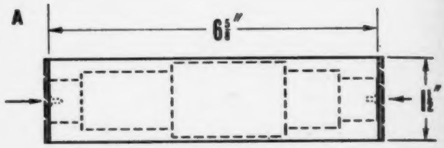


... and centre it too?



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CAN YOU FACE THESE HARD FACTS—

the time you are wasting on centering and facing bar stock or forgings in preparation for your centre or copy lathe?

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A JOURNAL OF METAL-WORKING PRACTICE & MACHINE TOOLS

Vol. 98, No. 2535 June 14, 1961

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CONTENTS

Abstracts of Principal Articles

Making Petrol Dispensing Pumps P. 1332

At their Crayford, Kent, works, Vickers Armstrongs (Engineers), Ltd., manufacture a wide variety of products, including petrol dispensing pumps for garage use, which are made under contract from the Gilbert & Barker Mfg. Co., Ltd., U.S.A. One of the most important components for these units is the meter body, which is made from an aluminium die casting. After machining a recess and face on one side and a bearing housing and face on the other, on capstan lathes, the four cylinders of each body are fine-bored on a Precimax machine. Liners are machined from precision-drawn brass tube on a Ward capstan lathe, and are then pressed into the cylinders of the body on a specially-built Vickers semi-automatic machine. Meter bodies are then drilled and tapped on a group of Archdale and Herbert machines arranged in a closed loop. Two jigs are employed, each with indexing work supports, and are moved along a track connecting the machines. (MACHINERY, 98—14/6/61.)

The A.E.I. Turbine-generator Works at Larne .. .. P. 1350

The Larne works, Northern Ireland, of the Associated Electrical Industries, Ltd., came into operation in 1957, and in floor space is the second largest in the four factories maintained by the company for the production of turbines and generators. In this article, reference is made to the heavy machining section of the works, and various set-ups are described, for example, for milling turbine half-casings on a 300-ton Kendall & Gent plano-milling machine; turning blade grooves in turbine bucket wheels on a Richards machine with special tooling; copy-turning bucket wheels on another Richards machine; and copy-turning bellows-type couplings on a Webster & Bennett 48-in. vertical turning and boring mill. (MACHINERY, 98—14/6/61.)

Russian Automatic Transfer Machines at the Leipzig Fair .. .. .. P. 1365

The fourth of a series on Russian machine tools shown at the recent Leipzig Spring Fair, this article describes an automatic in-line transfer machine designed for operations on cast iron bearing caps for a diesel engine, which are machined from cluster castings in a cycle time of 44·5 sec. The partly-machined caps are fed to a milling unit at the first station, and then turned on to one side for the remaining operations which provide for drilling and reaming the bolt holes, milling oil seal-grooves, spot-facing, chamfering, tapping, milling a joint face recess, and parting-off. To provide more time, the tools for drilling and reaming are duplicated, the operations being performed during two consecutive cycles of the remainder of the machine, and four different transfer bars are employed to index the work. At the milling stations, portions of the transfer track are mounted on brackets connected to hydraulic cylinders, whereby they are retracted to clear the milling spindle housings. Cycle control and tool control equipment is provided. (MACHINERY, 98—14/6/61.)

Equipment for Counting and Sizing Diamond Particles .. .. .. P. 1374

This article describes some of the equipment and procedures employed by Diadust, Ltd., one of the companies in the L. M. Van Moppes & Sons, Ltd., Group, for counting and sizing diamond powder, which is produced from boart and is widely used in industry throughout the world. Of particular interest is an automatic particle size analyzer which has been developed by Casella (Electronics), Ltd., Haxby Road, York. With this unit, a specially prepared sample of the dust, of sub-sieve size, is scanned automatically and the counts obtained from three successive scanning runs are substituted for symbols in a simple equation, which when solved provides the number of particles contained in an area of 1 sq. mm. (MACHINERY, 98—14/6/61.)

Churchill Grinding Machines at the British Trade Fair, Moscow .. .. P. 1376

Three grinding machines, fitted with automatic work loading and size control equipment were exhibited by the Churchill Machine Tool Co., Ltd., Broadheath, Manchester, at the British Trade Fair held recently in Moscow. A type BW machine was fitted with a newly-designed loading unit of the swing-arm type which is mounted on the tailstock, and operates in conjunction with a work conveyor positioned at the tailstock end of the bed at right-angles to the work axis. The type HBM internal grinder exhibited incorporates a recently-developed face grinding head, which can be brought into operation as part of the automatic cycle, also a new work-loading unit fitted with a swing-type transfer arm. On the type EC centreless machine, there is a rotary-type work loading unit, also a feed-back system, which operates in conjunction with an air gauging unit. (MACHINERY, 98—14/6/61.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

The Significance of Missile and Space Vehicle Production

About 17 years ago, the first reliable information became available in this country concerning the design and performance of the V2 rocket weapon, and it was made evident how far ahead Germany was at that time in this particular field. The V2 rocket undoubtedly was a remarkable accomplishment for those days, from the standpoints both of design and construction, yet even when all the evidence was at hand it is unlikely that more than a very few people could have anticipated the astonishing progress that has already taken place and which appears virtually to have robbed us of the capacity for further surprise. In this connection it is only necessary to refer to the matter-of-fact reception which was accorded to recent pronouncements by the President of the United States. He spoke of the intention of his country to land a man on the moon and bring him back safely to earth before 1970, and whereas even 15 years ago such a suggestion would probably have been generally regarded as the wildest flight of imagination, today it seems to be widely accepted that this feat will be achieved by the U.S.A. or Russia, or both, within the period suggested.

Development of rocket engines, guidance systems, and constructional features of missiles and space vehicles has, of course, been very powerfully stimulated by military considerations—as was the original production of the V2—and such stimulus is likely to be augmented in the future by intense national rivalry in the field of scientific exploration within a widening area. Leaving aside all considerations of the effectiveness of long range ballistic missiles for offensive or deterrent purposes, it is impossible yet to forecast all the advantages that may accrue to humanity from the knowledge that has been gained, and will be gained, from the ability to put satellites of increasing size into orbit, and to undertake voyages with manned or unmanned vehicles further and further into space. Even if much of this knowledge cannot be turned to practical account, it is inevitable that the process will continue now that the first steps have been successfully taken, and it would be rash to predict how far progress may have been taken by the end of this century.

It is already evident that only countries or groups of countries with great industrial resources could reasonably put forward the effort in the fields of research and production that any substantial space vehicle programme demands. Only those most intimately concerned can appreciate the full extent of the problems to be overcome before a manned landing on—and return from—the moon can be undertaken, for example. The return voyage, considered in isolation, will surely be difficult enough. Obviously the production of successful vehicles for such purposes will demand much more exacting standards than have previously been achieved. Many important advances have already been made in connection with the development of materials for various purposes in order to obtain the necessary strength-weight ratios, heat-resistance, and other properties that may be demanded, and much further progress in these directions may be anticipated. Similarly, new designs and methods of construction are the subject of intensive investigation with the object of progressively reducing structural weight while maintaining adequate strength. For many of the internal components and mechanisms, moreover, exceptional degrees of accuracy are essential, in conjunction with minimum size compatible with satisfactory functioning.

Above all, a degree of reliability must be ensured beyond anything that has been attempted hitherto. Although most or all of the vehicle or missile is expendable, and the working life of many parts may be very short, so complex is the whole that the possibility of error in each section must be reduced almost to vanishing point. To guarantee such dependability it may not suffice to rely on particularly searching inspection procedures, but it may be necessary to adopt a new approach and to bring a more highly developed sense of responsibility to bear at every stage of manufacture.

The development of quantity production methods in metal working, in which the motor car industry has consistently played such a prominent part, has had far reaching effects in many other branches of manufacture and incidentally on the living standards of the populations in all industrialized countries. More recently the requirements of aircraft construction, particularly since the gas turbine was introduced during the last war, have encouraged the development of improved materials and techniques of metal working which are already finding much wider application. Attention may be drawn, for instance, to the quantity production of titanium, which was

(*Continued on page* 1386)

Making Petrol Dispensing Pumps

Methods and Equipment Employed by Vickers Armstrongs (Engineers), Ltd., Crayford, Kent, for the Production of Metering Pump Bodies and Cylinder Linings

By P. A. SIDDERS, Chief Associate Editor

THE NUMEROUS COMPANIES within the Vickers group include Vickers Armstrongs (Engineers), Ltd., which has works located at Barrow-in-Furness, Newcastle-on-Tyne, Weymouth, Dartford, and Crayford. Vickers had an interest in a works on the site of the present plant at Crayford, Kent, prior to 1897, when the company was known as Vickers, Sons & Maxim, Ltd. Before the 1914-1918 war, the products of the Crayford works included automatic guns and the Wolseley motor car. During that war, the factory was occupied with the construction of aircraft, and by 1918, the number of employees at Crayford had risen to 12,000. It may be mentioned that the company built the S.E.5a fighter aircraft complete—engine, airframe and armament—at these works. Subsequently, the Vickers Vimy heavy bomber was produced, and one of the old hangars is still used as a heavy assembly shop.

After the first world war, the company had to find non-military outlets for the production capacity, and motor vehicle bodies were produced at Crayford. From 1921 to 1927 more than 12,000 motor car bodies and 1,000 commercial vehicle bodies were made, and later the Vickers Aussie tractor was built. In 1931, the plant and production activities of the neighbouring Erith works were transferred to Crayford, and during the 1930's, the latter factory was concerned with the building of fire-control equipment for naval and land-base use, box making machines, and hardness testing machines, in addition to the Vickers machine guns of 0·303 and 0·500 calibre, the production of which had continued from the war period.

The number of employees rose to 10,000 during the second world war, and the Crayford works was engaged in building fire control equipment and machine guns, also multiple 2-pounder pom-pom guns for naval use—the well-known "Chicago piano." With the cessation of hostilities, the demand for armaments fell off sharply, and a variety of commercial products was introduced. The Crayford factory has undertaken the building of plant for bottling beer and soft drinks, other brewery plant, butter processing machinery, paint processing equipment, packaging machinery, box making plant (including wire stitching and forming machines), hardness testers, a range of light-duty Clearing presses of 22, 32 and 45 tons capacity, and the petrol pumps with which this article is concerned, in addition to a certain amount of fire control equipment. During the post-war period, the company also produced a large volume of mechanical and electrical data processing equipment for the Powers Samas company, and still makes the P.C.C. electronic computer for I.C.T., Ltd.

There are now some 3,000 employees at the Crayford works, which has 1¼-million sq. ft. of covered floor area, some of this space being in multi-storey buildings. The facilities include a foundry (with a capacity of 120 tons per month), a forge, and machining and assembly shops. There is a well-organized apprentice school, which will form the subject of a future article.

The petrol pumps made at the Crayford works are built under an agreement between Vickers Armstrongs (Engineers), Ltd., and the Gilbert & Barker Mfg. Co., Springfield, Mass, U.S.A., who are associated with the Standard Oil Company of New Jersey. These pumps are sold by Gilbarco, Ltd., and are produced at a rate of several hundred per month, many thousand having been completed to date at the Crayford works. A typical pump is seen in the heading illustration, and there are numerous variants of the basic design, which include, for example, pumps with and without radial arms, with and without lighting, and with and without Calcometer units to show the total cost of the petrol dispensed. Pumps are made for a variety of currencies and measuring systems,

since they are exported in substantial quantities.

All the pumps are electrically operated and each incorporates a vane-type main unit which delivers petrol to a 4-cylinder meter unit. The latter serves to drive the calculating unit, supplied by Veeder-Root, Ltd., which determines and indicates the total volume delivered and its cost. Pressed steel components for the pump casing are made principally at the Crayford works and the Vickers Armstrongs Dartford factory, but certain pressings are obtained from an outside supplier.

OPERATIONS ON METER BODIES

The metering unit is one of the most important sub-assemblies in a petrol pump, since it is required by the Board of Trade to measure to an accuracy of −0, +1 fl. oz. per gallon. In the pumps made by Vickers Armstrongs (Engineers), Ltd., the metering units have die cast, aluminium alloy casings, each with four radially-disposed cylinders. Pistons are moved to and fro in the cylinders by the petrol delivered from the main pump, and impart rotary motion to a central shaft by means of cams. A valve directs petrol to each cylinder in turn, and the driven shaft is connected to the calculating unit mounted above. Die cast casings are supplied by an outside foundry, and a casing as received at the Crayford works is seen at the left in Fig. 1. It will be observed that the casting is of cruciform configuration with four similar arms, which are cored, as at *A*, to form the cylinders. There are numerous smaller cored holes, which are subsequently machined, to receive fixing screws and other members when the pump is assembled.

The first two operation stages in the machining sequence on meter bodies are carried out on Herbert No. 7 turret lathes. For the first stage, the casting is located on a fixture by a spigot that engages the cored recess *B*, which is subsequently machined to receive a part known as the "carbon deck." The casting is secured by strap clamps at either side, which are engaged with cored holes, as at *C*, in two opposed arms. At this machining stage, a large cast boss, indicated at *D*, is bored to receive a ball bearing, and this boss, also a service pad, as at *E*, on the cylinder head flange at the end of each arm, are faced. A dimension of 4·0865 in. ±0·001 in. is maintained from the pad faces to the die cast surface of the carbon deck seating.

For the second operation stage, the casting is loaded into a fixture whereon it is located by a spigot that is engaged by the previously-bored hole in the boss *D*, with the machined pads on the cylinder head flanges in contact with the face of the fixture, and is secured by strap clamps that enter the cored holes in two opposed cylinders. At this stage, the carbon deck seating is machined to 4·0605 in. ±0·001 in. from the service pads, and the surrounding flange is faced. The cored hole in the centre of the carbon deck seating is bored to receive a ball race, and the outer end is threaded 1-in. diameter by 16 t.p.i. Whitworth, as seen at *F*, in the component at the right.

FINE-BORING CYLINDERS

A brass liner is inserted in each cylinder bore, as will be described later, and the next operation in the machining sequence provides for fine-boring each cylinder to ensure the necessary close fit. In Fig. 1, a fine-bored casting is seen at the right, and a dimension of 2·224 in. ±0·001 in. must be maintained between the axes of the bores and the carbon deck seating face.

Fine-boring is performed on the single-ended, 2-

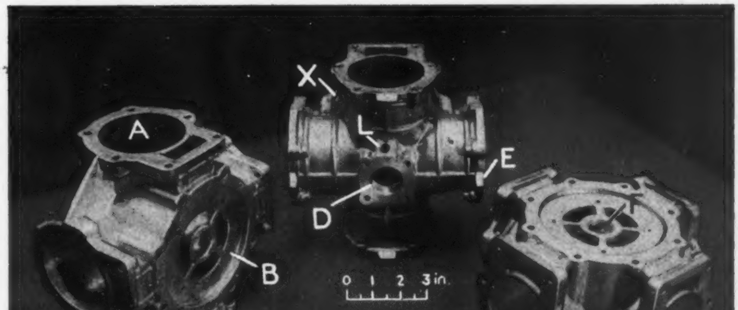


Fig. 1. A die casting for a meter body, as received by Vickers Armstrongs (Engineers), Ltd., is seen at the left; a casting after fine-boring, at the right; and a casting with the cylinder liners inserted and machining completed, at the centre

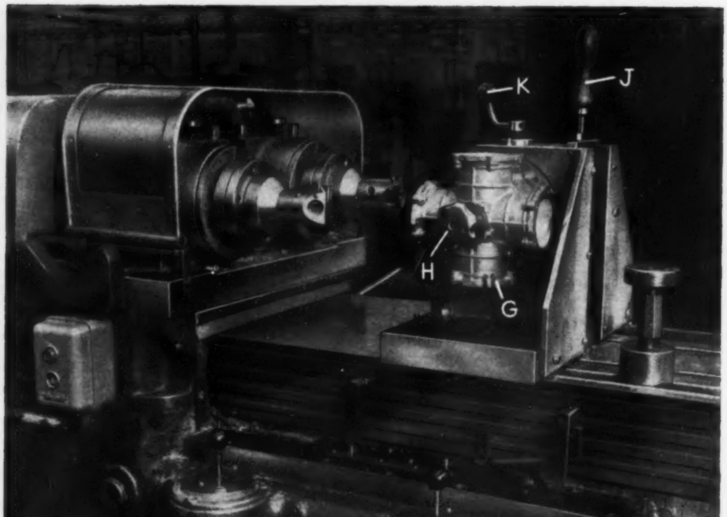


Fig. 2. The set-up for fine-boring the cylinders of meter bodies on a 2-spindle Precimax machine, equipped with a double-sided indexing fixture

spindle, Precimax machine shown in Fig. 2, a double-sided indexing fixture being mounted on the table. A workpiece, as seen at *G*, is loaded on to a platen at each side of the fixture, which has a cast-iron body of T-shape, braced with steel plates. The workpiece is located on the platen by a spigot which engages the previously-machined carbon deck recess, also by a peg which enters a cored hole in the surrounding flange. Thus located, the casting is retained by a C-washer and clamp nut *H*, on a stud that passes through the central bearing bores. Care must be taken by the operator to ensure that the clamping force is not excessive, otherwise the fine-bored hole will distort when the clamp is released.

The two platens of the fixture are mounted on a common axis, and are indexed together to any of four settings, at 90-deg. intervals. These settings are governed by holes in the flange at the front of the fixture, which are engaged by a sliding plunger. The plunger is thrust into engagement with the holes by a spring, and is withdrawn by means of the lever *J*. After the plunger has been withdrawn, the work is swung to the new setting by hand, and a clamp is applied by the lever-screw *K* in order to damp out vibration during cutting.

Boring bars of very rigid construction are mounted on the spindles of the Precimax machine, and each has a slot wherein a single-point tool insert is clamped. The inserts, which are supplied by English Steel Tool Corporation, Ltd., are of L-shape, with the shorter limb extending outwards from the bar, and a tip of Escaloy tungsten carbide is brazed at the outer end of each short limb. Of rectangular shape, each tip has a chip-breaker groove, parallel with the front edge (that is, radial to the bar axis), and is diamond ground and diamond lapped to a high finish. It is very important that there should be no tool return mark along the bore, since petrol is extremely penetrating, and such a mark could form a passage between the liner and the cylinder wall along which seepage might occur. At the end of each boring traverse, therefore, the machine is stopped, and the spindles are turned by hand, until an engraved line on each is aligned with an index mark on the front bearing retainer of the spindle head assembly. As a result, the tool is set in the top dead centre position, and the steady clamp of the fixture is then released. The operator next disengages the locating plunger, by means of the lever *J*, and turns the work slightly, so that the bore that has just been machined is inclined relative to the boring bar, with the outer end above the horizontal. With the cylinder in this setting, the work can be moved clear of the bar, without a tool return mark being formed in the bore.

For the fine-boring operations, the machine spindles are run at 950 r.p.m., and the table is advanced at a feed rate of 3 in. per min. Each bore is 2⅛ in. deep, and is machined to 2·821 in. -0, $+0{\cdot}0008$ in. diameter.

MACHINING CYLINDER LINERS

A cylinder liner is seen at *L* in Fig. 3, where it is resting on the cross-slide of the Ward 3A capstan lathe employed for machining the ends. Liners are machined from precision-drawn brass tube, and each is faced at both ends to a specific length.

One end is machined with a 45-deg. internal chamfer and a 15 deg. (a side) external chamfer, which serves as a lead-in, when the liner is assembled with the cylinder bore.

For the operations on the Ward lathe, a pre-cut length of tube is mounted on the expanding stub-arbor *M*, which has been fitted to the machine by Vickers Armstrongs (Engineers), Ltd. The arbor *M* has three pads, of arcuate section, which are mounted on a tapered member *N*, and held in place by a spring-steel circlip *P*. Each pad has a flange at one end, which is engaged by the flange of the nose cap *R*. This cap is screwed on to the end of the ball cage that forms part of the operating mechanism for the dead-length collet chuck normally fitted to the Ward lathe*, the cage being bolted to the mounting flange on the machine spindle.

The stationary outer casing S, secured to the machine headstock, is fitted with pins and guides that engage helical slots in a rack case. Gear teeth cut on the periphery of the rack case are engaged by a pinion actuated by the lever *T*, and the case can thus be partially rotated. As the case is turned, it is displaced axially by the action of the helical slots and the guides, and a ball-operating sleeve, carried between thrust bearings within the case, is also moved. In consequence, an annular groove in the sleeve engages and moves inwards balls that are housed in the ball cage, and these balls thrust an inner sliding sleeve forwards. This sleeve normally closes a dead-length type collet, but is here coupled to the tapered member *N*, which is moved axially to expand the three pads of the arbor *M*, within the bore of the workpiece. By moving the lever *T* in the opposite direction, the balls are allowed to move outwards, and the sleeve and tapered member are moved back by the action of a spring, so that the three pads of the arbor *M* are contracted, and the workpiece is released.

As each liner is unloaded from the Ward lathe, it is placed in a special trolley-rack at one side of the machine. This rack may be seen in the background in Fig. 4, and it has four sloping shelves, which are divided into channels by wooden strips.

* This unit is fully described on p. 57 of "Capstan and Turret Lathe Practice," in MACHINERY's Standard Reference Series.

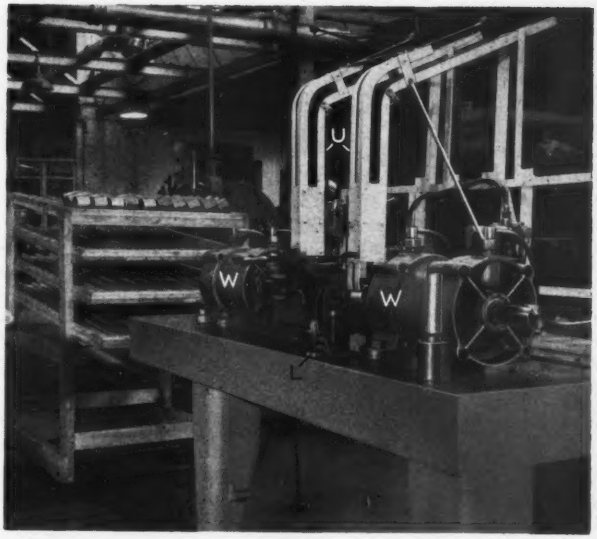


Fig. 4. General view of the special air-operated machine for pressing liners into the cylinders of meter bodies. During a semi-automatic cycle, two liners are inserted, the work is indexed, and two further liners are inserted

Fig. 3. This internally-expanding work support for brass cylinder liners has been fitted to a Ward capstan lathe by Vickers Armstrongs (Engineers), Ltd., and is actuated by the standard hand-operated collet mechanism

As each liner is placed in a channel, it rolls down towards the lower end of the shelf, and the channels and shelves are filled successively. When the rack has been completely filled, it is moved on its wheels to the position shown, whence liners can be readily removed from the lower end of each shelf by the operator of the liner-inserting machine in the foreground of the figure.

LINER-INSERTING MACHINE

The liner-inserting machine has been designed and constructed by Vickers Armstrongs (Engineers), Ltd., and is semi-automatic in operation. Built on a large cast-iron surface plate, the machine is operated by compressed air, at a pressure of 80 lb. per sq. in., and incorporates pneumatic valves and cylinders supplied by Baldwin Instrument Co., Ltd., Dartford, Kent.

Liners are loaded into the two magazine chutes *U*, with their externally-chamfered ends inwards. The stack of liners in each chute is urged towards the lower end by a cylindrical steel weight, which is placed in the chute at the upper end of the stack. This weight has a central annular groove to which is attached a length of thin, flexible steel cable, the other end of this cable being secured to a small bracket at the extreme upper end of the chute. When the stock of liners in the chute needs to be replenished, the operator can readily withdraw the weight by means of the cable. The lowermost liner in each chute rests in V-section guideways in a block at one side of the box-type work-fixture on the bedplate. Liners in this position are indicated at *V* in Fig. 5, and are aligned with holes in the side of the fixture, also with the rams of air cylinders of 9 in. bore, seen at *W* in Fig. 4 and 5.

The fixture is constructed from steel plate, and the liners are an easy sliding fit in the hole in each side wall. A circular plate is free to rotate in the fixture base, and incorporates a shallow spigot of a diameter to suit the carbon deck recess, also a peg for angular positioning of the work. This method of location is the same as that employed on the fixture fitted to the Precimax fine-boring machine. The work is held on the circular plate by means of a spring-loaded plunger *X*, Fig. 5, fitted to the perforated-metal lid *Y* of the fixture, this lid being mounted on a bar that is pivoted on the rear wall of the unit. Perforated metal is employed for the lid to permit the operator of the machine to observe the work, if needed. The support bar extends beyond the front of the lid, and when the latter is closed, the bar trips the lever-operated valve *Z*, mounted on the front wall of the fixture. Unless this valve is tripped, the machine cannot operate, and the lid is held closed by a spring-loaded catch, which engages an angular step-face on the bar. The engagement of the catch can be adjusted by the knurled nut *A*, and this nut also serves for withdrawing the catch to enable the lid to be opened.

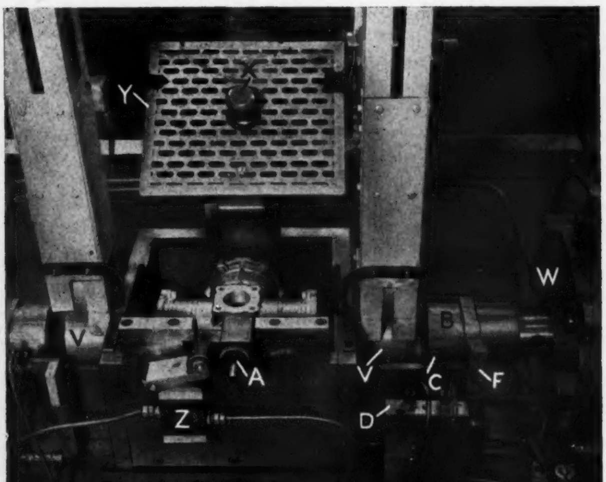


Fig. 5. The fixture for meter bodies and the ends of the magazines for liners on the semi-automatic inserting machine

Before a metering unit body is placed in the fixture, shellac varnish is applied to all four cylinder bores to eliminate any possibility of petrol seepage. The arrangements for applying varnish will be described later.

Once the lid of the fixture has been closed, the machine operates on an automatic cycle, and the pistons of the two cylinders are advanced simultaneously. On the end of each piston rod is fitted a thrust block, as at *B*, which is of cylindrical form, with an integral flange about midway along its length. The front end of the block is machined to receive a transverse bar *C*, of square section, and has a small angular face at the top. As each piston is advanced, the thrust block engages the lowermost liner in the stack and pushes it along the guideways, through the hole in the fixture wall and into the cylinder bore at one side of the metering valve

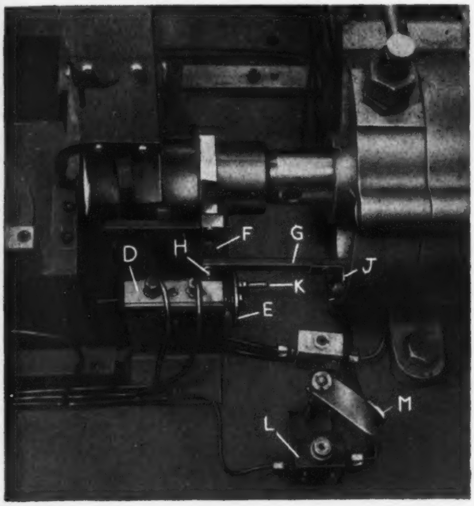


Fig. 6. The thrust block, trips, and control valves at one side of the liner inserting machine can be clearly seen in this close-up view

body. The chamfer on the leading end of the liner not only facilitates entry into the cylinder bore, but also forms an annular recess at the inner end of the cylinder to receive excess shellac varnish that is forced along the bore.

Movement of the thrust block inwards is limited by the transverse bar *C* coming into contact with the side wall of the fixture. During this movement, the remaining liners in the stack are lifted slightly by the angular face at the front end of the block, and rest on its upper surface.

CYCLE CONTROL ARRANGEMENT

It may be noted that the machine is arranged for pilot-valve control, the main valves whereby air is supplied to the two operating cylinders being mounted on the frame at the rear of the base. The valve Z, to which reference has already been made, is incorporated in the pilot circuit, and at either side of the fixture there is a reversing pilot valve, as seen at *D*. This valve is also shown in the close-up view, Fig. 6, and on the end of the spool is mounted a disc-type striker *E*.

The flange of each thrust block carries a vertical bar *F*, which travels along the outside of the V-section guide block. An L-shaped plate is secured to the bar *F*, by screws which pass through the shorter vertical limb of the L-form. The longer, horizontal, limb, seen at *G*, carries a fixed dog *H* at one end. At the other end there is a second dog *J*, which is secured by a domed-head screw that passes through a slot. This dog is so positioned that it engages the striker *E* and resets the valve *D* at the end of the inward movement of the thrust block. In consequence, the main valve connections are reversed, and the thrust block is moved in the outwards direction, until the dog *H* contacts the striker *E*. The valve *D* is then returned to its original setting and the next inward movement is initiated. Adjustment is provided for the dog *J* to allow for the slight time lag between the tripping of the pilot valve and the reversal of the air supply to the operating cylinder by the main valve.

At its lower end, the bar *F* (on the right hand side of the machine only) is forked, and embraces a connecting-rod *K*. This rod passes through the side-wall of the fixture and serves to actuate a pawl and ratchet mechanism in the fixture base, whereby the circular work-support plate is indexed through 90 deg. At the end of each outward movement of the right-hand thrust block, the bar *F* contacts a nut and moves the rod axially. Timing of the in-

Fig. 7. An automatic dispensing unit built by Vickers Armstrongs (Engineers), Ltd., for applying shellac varnish to cylinder bores before the liners are inserted. A pump body with the liners assembled is seen at the left

dexing movement is effected by adjusting the nut along the threaded end of the rod. Dogs, fitted to the work-support plate, trip a pilot valve at the rear of the fixture to stop the machine after two indexing movements have been completed. The reversing valves at either side of the machine then remain inoperative until the next cycle is started by closing the lid and tripping the valve *Z*, Fig. 5.

A valve *L*, Fig. 4 and 6, serves as a master control. The machine operates as long as the operating plunger of this valve is held down, and the plunger is depressed by hand for setting and similar purposes. When the machine is to operate on an automatic cycle, the plunger is held down by a thumb-screw *M*, carried in a swinging arm on a pillar fitted to the machine base.

VARNISH APPLICATOR

Fig. 7 shows the unit that has been designed and made by Vickers Armstrongs (Engineers), Ltd., to facilitate the application of varnish to the cylinder bores of the meter body. A component, after the brass liners have been inserted, is seen at the left. The varnish is composed of shellac dissolved in methylated spirit, and a supply of approximately ½ pt. is contained in the reservoir *N*. Supported by a spring *P*, the reservoir is free to slide on a pillar that projects vertically from a base, which is screwed to a bench adjacent to the bush inserting machine. At the top of the pillar is mounted a steel disc which supports a ½-in. thick pad *S*, comprising a circular piece of sponge rubber, sandwiched between two fabric discs. The end of the pillar passes through the pad, which is secured by a large steel washer and a set screw.

Normally, the reservoir is supported by the spring so that it completely encloses the pad, which then lies within the varnish in the reservoir, but it has been set in the position shown for purposes of illustration. The upper end of the reservoir is machined to form an outer annular seating face and an inner register spigot *T*, of truncated conical form. Each cylinder of the meter body is located over the spigot in turn, and is first centralized by engaging the bore with the spigot. The meter body is then pressed downwards, and the reservoir is thus thrust vertically down the pillar so that it moves clear of the pad *S*, which is charged with varnish. As the bore of the spigot passes over the pad, the latter is compressed slightly, to remove excess varnish, and when the pad is freed from the spigot it expands into contact with the cylinder bore of the meter body. During the remainder of the downward motion, the wall of the bore slides over the pad and is coated with a thin layer of varnish.

The travel of the reservoir is such that the meter body stops with the pad ¼ in. clear of the inner end of the bore. Since the spigot extends into the bore for ¼ in., there is a similar band that is free from varnish at the outer end of the bore. At the completion of the downward movement, the meter body is raised, and the reservoir rises with it until the pad is once more fully enclosed, the pump body then being lifted clear. All four cylinder bores are coated with varnish in this manner before the meter body is passed for bush insertion.

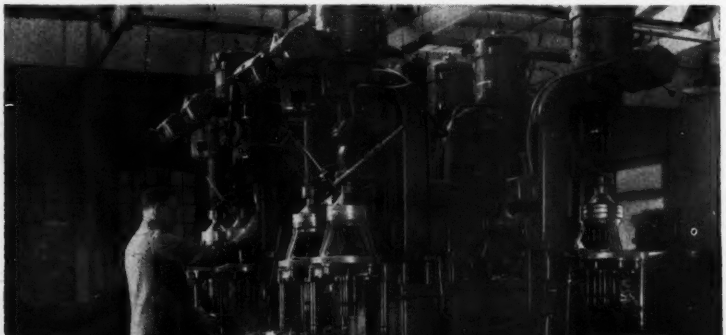


Fig. 8. This group of machines connected by a closed-loop trolley-jig track provides for drilling and tapping holes in the meter bodies after the liners have been inserted

CLOSED-LOOP DRILLING AND TAPPING LINE

From the bush inserting machine, meter bodies are loaded on to stillages with castoring wheels, whereon they are transferred to a group of machines that provide for drilling and tapping various holes. A general view of the installation is given in Fig. 8, and it will be seen that the machines are arranged in two rows, back to back. There are two twin-spindle Archdale machines, with a single-spindle Herbert machine between them, in the row at the left in the illustration, and the other row consists of two twin-spindle Archdale machines. The tables of the machines are arranged at a common height and support an oval track, the ends of which are mounted on pillars. This track provides for the movement of two trolley-type jigs, which are coupled together and are transferred from machine to machine by the operator, who moves round a wooden plinth.

All the spindles of the Archdale machines at one side, and three of the spindles of the machines at the other side, are fitted with multi-spindle heads, which are of adjustable-centre type, made by an outside supplier to Vickers' specification. Each head is fitted with two long cone-ended guide pillars, which enter bushed holes in the jigs. The pillars are disposed diagonally, and on the heads employed for drilling operations, they also serve to support a spring-loaded bush plate.

The two jigs differ in design, but each has three rollers—one at the front and two at the rear—that run on the angle-section rails of the oval track. On account of the 3-point support thus formed, the spacing of the rails is narrower at the semi-circular ends of the track than it is at the sides.

DRILL JIG DESIGN

As indicated above, the two jigs employed on the closed-loop line are coupled together, and for convenience will be referred to as the leading and trailing jigs. A meter body is first loaded into the trailing jig of the pair, and a view of this unit is given in Fig. 9. At the rear of the jig base there is a bearing bracket which carries a circular work-support plate, just visible at *U*. This plate incorporates a spigot, with which the carbon deck recess of the meter body is engaged, also two fouling pins *V* and a fork *W*, the latter being secured by screws in a slot in the edge of the plate. When the meter body is loaded, the fork ensures that it is located in the jig at the correct angular setting for subsequent drilling and tapping of the hole *X*, Fig. 1, in a broad web between two of the cylinders.

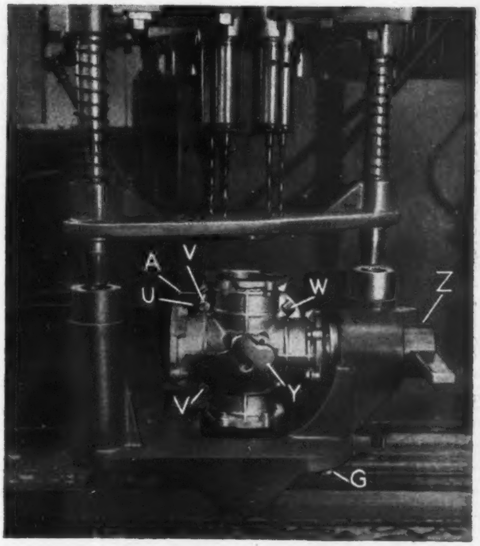


Fig. 9. The trailing jig of the pair used for drilling and tapping meter bodies. This jig provides for holding the body while holes are machined in each cylinder head flange, also at an angular setting between two cylinder positions

The meter body is held on the support plate by the hand nut *Y*, Fig. 9, which engages the thread on a stud that passes through the centre. To facilitate loading, the nut has a clearance hole (slightly larger than the major diameter of the thread) machined at a small angle to the tapped hole, and co-axial with it at the inner end of the nut. The tapped hole is accurately square with the inner face of the nut, which bears against the work, and when the nut is assembled, it is tilted slightly so that it can be passed easily over the stud by way of the clearance hole. As the end face is thrust against the mating face of the work, the nut is realigned square with the stud, and the partial threads engage those of the stud. It is then only necessary to give the nut about half a turn to clamp the component securely on the support plate.

Drilling and tapping of the holes in the cylinder head flanges, also in the web, are performed with the work in the trailing jig. For operations on the cylinder head flanges, the work is located by a large plunger *Z*, at one side, which is moved by a lever pivoted at the rear of the jig frame. This plunger is engaged with each cylinder bore in turn, for operations on the flange of the cylinder

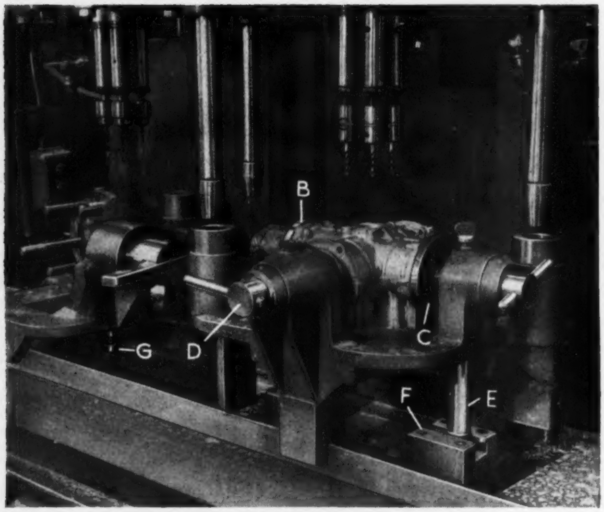


Fig. 10. The leading jig of the pair on the closed-loop machine line. This jig provides for drilling and tapping operations on the small bearing boss at one side of the meter body, and the carbon deck face and flange on the opposite side

that is then positioned vertically. For drilling and tapping the angular hole (*X*, Fig. 1), the component is positioned by a smaller sliding plunger at the rear of the jig. This plunger is actuated by a lever *A*, and enters a hole in the work-support plate.

The leading jig of the pair is seen in Fig. 10, and provides for operations on the holes associated with the carbon deck and the bearing boss (*D*, Fig. 1). At opposite sides of the jig there are bearing brackets carrying a spigot *B*, which is free to rotate but is restrained axially, and a spigot *C*, arranged both to rotate and slide. A meter body is loaded with the cylinders in a horizontal plane, and one cylinder bore is engaged with the spigot *B*. The spigot *C* is then advanced to engage the cylinder bore on the opposite side of the work, and can be locked axially by a thumb screw. At the front of the jig there is a sliding plunger to engage the cylinder bores, the end of which is indicated at *D*. This plunger is engaged with one of the two remaining cylinder bores to hold the work horizontal with the bearing boss uppermost. When required, the plunger *D* can be withdrawn, the component swung through 180 deg. about the spigots *B* and *C*, and the plunger re-engaged with the fourth cylinder bore, to locate the workpiece with the carbon deck seating uppermost.

Below each jig there are two stout vertical pins, as at *E*, each with an annular groove near its lower end. At the stations employed for tapping, these pins engage T-slots in blocks mounted between the rails of the track, one of these blocks being indicated at *F*. The pins and blocks prevent the jigs from lifting as the taps are withdrawn, and one of the shorter pins fitted to the trailing jig is seen at *G* in Fig. 9 and 10.

OPERATION SEQUENCE

As previously mentioned, a meter body is first loaded into the trailing jig of the pair. Loading is carried out between the single-spindle Herbert machine and the second twin-spindle Archdale machine on the left-hand side of the installation, as viewed in Fig. 8. At this position, a workpiece on which the operations on the first Archdale and the Herbert machine have been performed is transferred from the trailing to the leading jig, which is empty at this stage, and is replaced by a fresh casting. The fresh and partly-finished components then move round the circuit together.

At the first station of the circuit (at the left-hand spindle of the first Archdale machine, seen at the extreme left in Fig. 8), holes are drilled in the flange of each cylinder, and are subsequently tapped for the cylinder head fixing screws. There is a 6-spindle drill head at this station, and each spindle is fitted with a combination drill and countersink. Each drill produces a hole of 0·257 in. diameter and the depth of the countersink is equal to one thread pitch. A spindle speed of 1,000 r.p.m. is employed, and at this, and all other stations, the machine spindle is fed downwards by hand. Each cylinder flange is drilled in turn, the meter body being indexed in the jig between successive operations.

The holes are tapped with a $\frac{5}{16}$-in. Whitworth thread at the second station (right-hand spindle of the first Archdale machine). Fast-spiral taps supplied by the English Steel Tool Corporation, Ltd., are employed, and are run at 153 r.p.m.

Drilling and tapping of the hole *X*, Fig. 1, are performed next, and the workpiece is indexed to the required setting with the aid of the auxiliary plunger on the fixture. The Herbert single-spindle machine employed for this stage is fitted with a combination drill and tap made by Vickers Arm-

strongs (Engineers), Ltd., and this tool is seen in the close-up view, Fig. 11. A hole is cored in the required position in the casting, and the combination tool incorporates a core-drill portion *J*, with two straight flutes, to open out the hole in the casting to the required size for tapping, and a tap portion *H*, with four flutes, to produce a ⅜-in. B.S.P. taper thread. The tool is made from solid high-speed steel, and more than 2,000 components have been drilled and tapped without regrinding the cutting edges. Special gears, made by the company, have been fitted to the Herbert machine, and give a spindle speed of 890 r.p.m. for drilling, and of 180 r.p.m. for tapping, speed changing being performed by the operator.

After the meter body has been transferred to the leading jig, and a fresh component has been loaded into the trailing jig, the leading jig is advanced to station 4, beneath the left-hand spindle of the second Archdale machine. Here, four holes, of 0·153 in. diameter, are drilled and countersunk in the boss surrounding the hole *D*, Fig. 1, at a spindle speed of 100 r.p.m., with combination tools. These holes, which are subsequently tapped for the screws that secure the ball-bearing retaining plate, are countersunk to a depth equal to one thread pitch. Tapping of the ¼-in. Whitworth thread in each hole is carried out at the second station of the Archdale machine, and, again, fast-spiral taps supplied by English Steel Tool Corporation, Ltd., are employed.

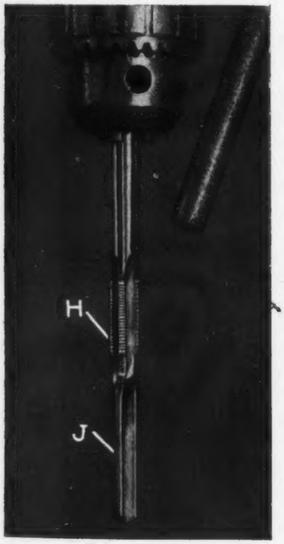


Fig. 11. Close-up view of the combination core-drill and tap made by Vickers Armstrongs (Engineers), Ltd., for machining an angular hole between two cylinders of the meter body. 2,000 components have been handled without regrinding

The jigs are now moved round the end of the track, and the meter body in the leading jig is inverted before it is located beneath the left-hand spindle of the first Archdale machine of the second group. A jig and workpiece are seen at this station (No. 6) in Fig. 12, and the machine quill is fitted with a 12-spindle head for drilling and countersinking holes in the carbon deck face and surrounding flange. The eight holes in the flange are drilled 0·257 in. diameter, and the four holes in the carbon deck face, 0·161 in. diameter. Combination drill and countersink tools are again employed, and are run at 955 r.p.m. Coolant is supplied to the tools by way of the ring-type manifold pipe *K*, which is mounted on the guide pillars of the multi-spindle head. In this instance, it may be noted, there is no guide-bush plate. The coolant employed at this and all other stations is a water-base soluble oil emulsion, to which Wynn's Friction Proofing (Metal Protection Products, Ltd.) has been added in accordance with the supplier's recommendations.

Fig. 12. Close-up view of the head for drilling 12 holes in the carbon deck face and surrounding flange. Soluble oil coolant, with Wynn's Friction Proofing added, is applied to the work from a ring-type manifold

Tapping of the eight larger holes, to $\frac{5}{16}$-in. Whitworth by ⅜ in. deep, is performed at the adjoining station, at a spindle speed of 96 r.p.m. The four smaller holes are tapped No. 10-32 t.p.i., U.N.F. form, by ½ in. deep, at the next station—the first on the second Archdale twin-spindle machine, at this side of the line. For both these operation stages E.S.T.C. fast spiral taps are used.

Finally, at the second spindle of the second Archdale machine, the hole *L*, Fig. 1, is drilled and

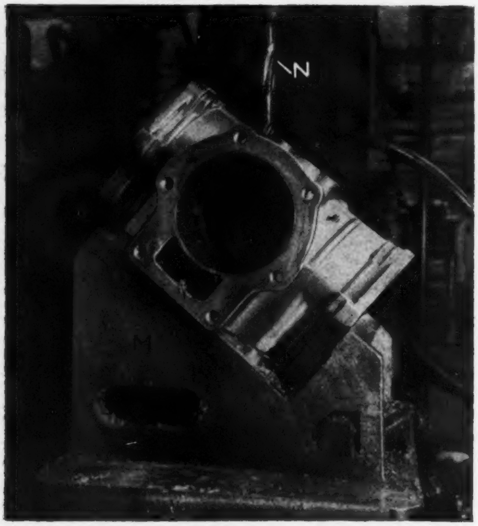


Fig. 13. This simple fixture is used for operations on an angular hole adjacent to the bearing boss at one side of the meter body, for which a combination drill and tap with spiral flutes is employed

tapped. The set-up for this tapping operation is seen in Fig. 13, the meter body having been removed from the leading jig of the pair on the track, and transferred to a simple fixture *M*. Of angle-plate type, this fixture is mounted on an auxiliary table fitted to the Archdale machine above the main table which supports the transfer track. The workpiece is loaded with the carbon deck flange in contact with a steel seating plate on the fixture body, and one cylinder head flange in contact with an abutment face at 90 deg. to the seating plate. It is then thrust transversely until the cylinder head face at the rear contacts a peg that projects from the seating plate.

A high-speed steel combination tool is used for drilling and tapping, as seen at *N*. This tool was made by Vickers Armstrongs (Engineers), Ltd., and produces a ⅛-in. B.S.P. taper thread. It incorporates a 4-flute tap portion and a 2-flute drill portion, and the flutes are of spiral form, since it has been found that straight flutes give rise to distortion of the hole, due to the angle at which it breaks through into the interior of the component. Drilling and tapping are performed at the same speed, namely, 314 r.p.m.

After drilling and tapping have been carried out, the finished meter body is placed on a wheeled stillage, and the two jigs are transferred to the other side of the loop line where the first series of operations is performed on the workpiece in the trailing jig. The total time required for the drilling and tapping operations described is 9½ min.

When the stillage is fully loaded with finish-machined meter bodies, it is transferred to a cleaning station, where the bodies are washed out with hot soda solution. Blow-off plugs are then fitted, and each body is subjected to a water test, after which it is dried and passed to the assembly section.

Machining of other components for petrol pumps, and assembly operations, at the Crayford works of Vickers Armstrongs (Engineers), Ltd., will be described in subsequent articles to be published shortly in MACHINERY.

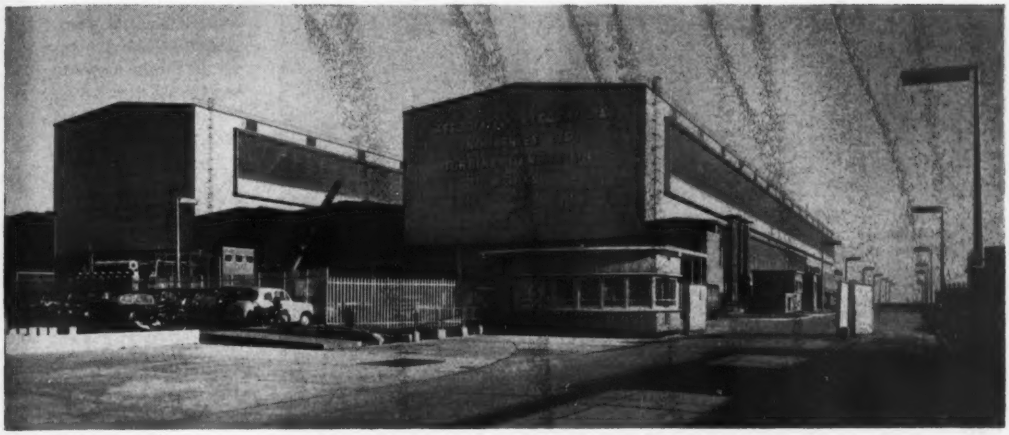
Deposition of High-purity Tungsten

Developments in guided missiles and space travel call for materials that can withstand high temperatures and maintain some measure of structural strength. Among the small number of suitable materials, tungsten is outstanding, since it has the highest melting point of all metals, namely 3,400 deg. C.

Until recently, however, the valuable high-temperature properties of tungsten could not be effectively utilized, since the brittleness and hardness of the metal prevented it from being machined by conventional methods and the relatively high weight restricted its use, in the solid form, in aircraft equipment.

For these reasons, efforts were made at the U.S. National Bureau of Standards to develop a practical method for depositing tungsten coatings. As a result of this work, high-purity tungsten can now readily be plated on metal surfaces by using a vapour deposition process developed independently by the Bureau, and by the U.S. Bureau of Mines. The method involves reducing gaseous tungsten hexafluoride with hydrogen by passing it over the heated object to be plated. At temperatures above 300 deg. C., tungsten is deposited on the hot surface, and the only other reaction product, namely, hydrogen fluoride, passes out with the excess hydrogen.

With this method, pure tungsten coatings in thicknesses up to ⅛ in., can be deposited in a fairly smooth condition. It is possible to coat a variety of metals, also ceramic surfaces of such parts as rocket and missile nozzles, and jet engine components. Since a thick coating can be formed, this technique also lends itself to the fabrication of tungsten components.



The A.E.I. Turbine-generator Works at Larne

Some Aspects of the Factory and of the Machine Tools and Equipment

By A. W. ASTROP, Associate Editor

FOUR MAJOR PLANTS of Associated Electrical Industries, Ltd., are devoted to the production of turbines, generators, and associated equipment, and in floor space, the factory at Larne, Northern Ireland, is second only to that at Trafford Park, Manchester. The four factories present a total floor area of 1,423,000 sq. ft., of which 533,000 sq. ft. are at Traffork Park and 470,000 sq. ft. at Larne. At Rugby, the area is 260,000 sq. ft., and at the fourth plant at Petershill, near Glasgow, which is mainly devoted to heat-exchanger equipment, 160,000 sq. ft.

The Larne works is the most modern in the group of four, having been brought into operation as late as 1957, and it occupies an imposing site on the cliff-top, overlooking the Irish channel. There are two main covered areas at the Larne works, namely the heavy-machining and erection shop and a slightly smaller building devoted to the quantity-production of turbine blades in a wide range of sizes and designs. Details of some of the methods employed for making blades will be given in further articles to be published shortly. Here, the heavy machining area of the main building is considered, and a general view of a portion of the exterior of this section is given in the heading illustration.

There are seven bays, each measuring 900 ft. long, with widths ranging from 25 to 100 ft., and two of these bays are considerably higher than the remainder, as can clearly be seen. One of the high bays has a clearance of 89 ft. below the roof trusses, and is equipped with travelling cranes at two levels. The lower crane has rails at 48 ft. above floor level, and the higher, at 69 ft., and loads up to 200 tons can be lifted in this area. The other "high" bay, at the right in the heading illustration, has a clearance of 74 ft. below the trusses, and the crane rails are at 43 and 63 ft. above ground level. Loads up to 75 tons can be lifted in this area. There is an eighth bay, at the far end of the factory as shown, which extends at right angles to those just mentioned, and is 50 ft. wide. Excluding the high bays, the clearances between the roof trusses and the floor are typically 40 ft., 30 ft. and 29 ft., and cranes with lifting capacities of 75, 50, 30 and 10 tons are provided. With the exception of the high-level crane in the highest bay, all other cranes in the main building can be "doubled" in order to increase the lifting capacity.

Fig. 1. General view of one of the "high" bays in the heavy-machining section of the A.E.I. turbine-generator works at Larne, Northern Ireland

Favourably placed in relation to the port facilities at Larne and Belfast, where additional quays have recently been built, the works are connected with these centres by new and improved roads. By means of the Larne-Preston ferry service, loads up to 45 tons can be transported on road vehicles to any destination within Great Britain, without intermediate off-loading. Loads in excess of 45 tons, up to a maximum of 200 tons, are despatched by sea, from Belfast.

A general view inside one of the high bays, showing a part of the heavy-machining section, is given in Fig. 1, which affords an indication of the internal design of the works and of the clean lines and freedom from obstructions which facilitate manœuvring large castings and sub-assemblies. The roof is of aluminium, covered with 3-layer felt and ½-in. limestone chippings, and is glazed with ¼-in. Georgian wired glass.

At the left in Fig. 1 can be seen part of a Kendall & Gent 300-ton plano-milling machine, which is equipped with two vertically-mounted milling heads and has provision for one side head. The table on this machine has a stroke of 32 ft., and it will admit workpieces up to 12 ft. wide by 8 ft. 6 in. high. In Fig. 2 is shown a close-up view of a typical operation on this machine, namely, the milling of the joint surfaces on a half-casing for a turbine. The spindle quill is of 15 in. diameter, and the cutter here seen measures 17 in. diameter. This machine was described in detail in MACHINERY, 93/315 — 6/8/58, and another article (in MACHINERY, 90/991—3/5/57) was concerned with two 6-ft. square Kendall & Gent plano-milling machines which are also installed at the Larne works.

A feature of the largest Kendall & Gent machine is the provision of horizontal slideways on the back

Fig. 2. Set-up on a 300-ton Kendall & Gent plano-milling machine for operations on the joint faces of a turbine half-casing

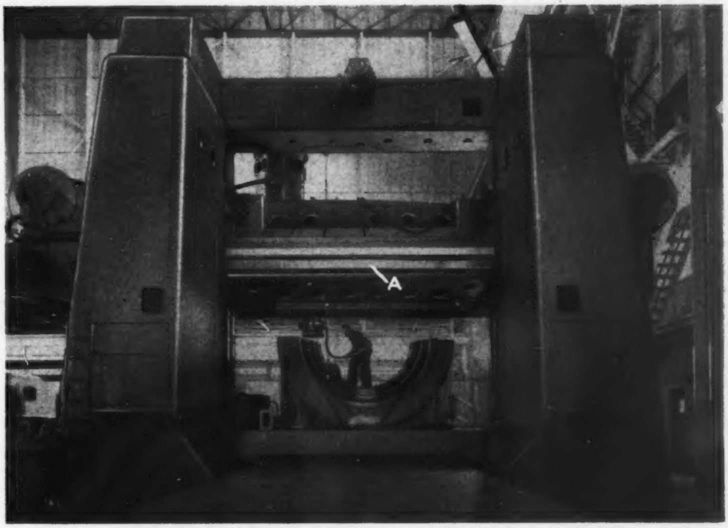


Fig. 3. Rear view of the large Kendall & Gent machine showing the slideways on the back of the cross-rail whereon a heavy-duty drilling head can be mounted

face of the cross-rail, as can be seen at *A* in Fig. 3, which is a view from the rear. The massive proportions of the machine are clearly apparent in this figure, and it may be noted that the operator is making use of a portable-type push-button box to control the various machine movements. On the slideways indicated at *A* can be mounted an Asquith OD 5 drill head, of the type used on one of that company's standard radial drilling machines, and a rack is provided on the back of the cross-rail whereby the head can be adjusted transversely to the required position. With this arrangement, drilling operations on the joint face of a turbine half-casing can be carried out at the same set-up as for milling, and considerable reductions in handling time are thereby achieved.

At the right-hand side of the gangway in Fig. 1, in the middle-distance, can be seen one of a pair of Craven heavy-duty turning and boring mills, which have 16 and 18 ft. diameter work-tables. The smaller machine will admit workpieces up to a maximum height of 10 ft. 8 in., under the cross-rail, and the work-table is driven by an 80-h.p. motor. This machine weighs 126 tons, whereas the 18-ft. machine weighs 135 tons, and will admit workpieces up to a maximum height of 12 ft. 9 in. Also visible in Fig. 1 is a Butler No. 8 spiral-electric planing machine, which has a 24 ft. long work-table and will admit workpieces measuring 8 ft. wide by 7 ft. high between the columns and under the cross-rail.

Other large machines in this high bay include: 10-ft. and 11-ft. radial drilling machines, a 10-in. horizontal, travelling-column, boring and milling

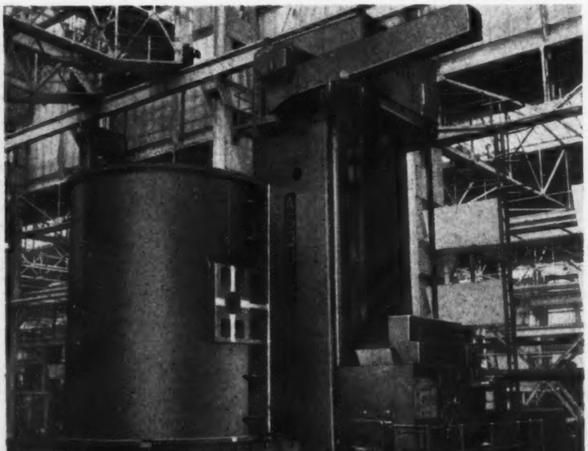


Fig. 4. Typical set-up on one of the two Asquith ram-type travelling-column boring and milling machines. With the aid of several attachments, multiple operations are performed on the stator casing here shown

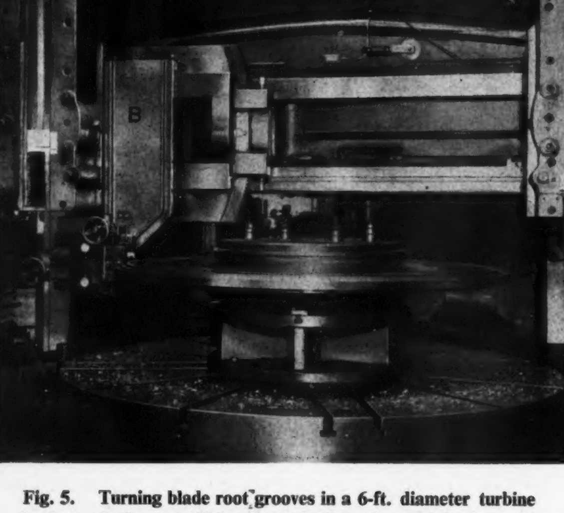


Fig. 5. Turning blade root grooves in a 6-ft. diameter turbine bucket wheel on a Richards vertical turning and boring mill which is one of two for operations on bucket wheels

machine, with horizontal and vertical traverses of 20 ft. and 15 ft., a horizontal drilling, boring and milling machine, with horizontal and vertical traverses of 24 ft. and 10 ft. (all by William Asquith, Ltd.) and a 27½-in., type CRS sliding, surfacing and screw-cutting lathe by Craven Bros. This machine will swing 54 in. diameter over the bed (42 in. diameter over the saddle) and will accept workpieces up to 23 ft. long between centres. For in-line boring operations—on turbine casings, for example—there is a large Noble & Lund traversing headstock machine.

One of the most impressive machines in the other high bay is the Asquith 10-in. spindle ram-type horizontal boring and milling machine shown in Fig. 4. This machine, which was described at some length in MACHINERY, 91/1397—13/12/57, is here seen set up for face-milling operations on a fabricated steel stator housing, and the 28-in. wide by 36-in. deep rectangular-section ram that houses the spindle is clearly shown. The spindle head has a vertical movement of 15 ft. on the column, and the latter has a horizontal movement of 33 ft. on a bed member which is sunk in the floor. Of the indexing type, the work-table is arranged for movement towards and away from the column on a sub-bed, which is arranged at right-angles to the main bed.

The multiple operations carried out on the stator housing at this set-up—some with the aid of various attachments—include: milling the feet; milling various pads on the sides; boring the hole in the pad on the side nearer the camera; and milling the cooler pockets. Among the attachments available for use with this Asquith machine may be noted: a universal milling head, which has two 360-deg. swivelling movements about axes that are mutually inclined at 45 deg.; a right-angle milling head; and two surfacing slides, with capacities of 2 and 4 ft. diameter.

In another bay, there is a pair of Richards

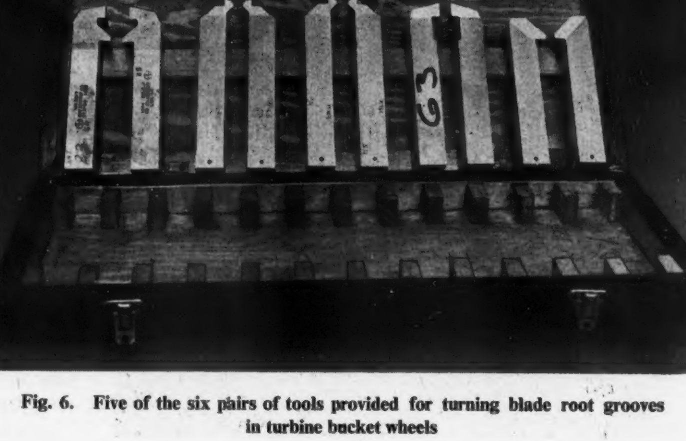


Fig. 6. Five of the six pairs of tools provided for turning blade root grooves in turbine bucket wheels

vertical turning and boring mills which are employed for operations on bucket wheels for rotor shafts, among other workpieces. A typical set-up on one of these machines, for turning a number of concentric grooves near the periphery of the wheel, is shown in Fig. 5. When these grooves have been machined in both faces a modified form of fir-tree section is obtained. Each blade for this wheel has a forked end, with tongues on the inner faces of the fork which mate with the grooves in the wheel. At one point, the grooves are subsequently milled away on both sides of the wheel, to provide a loading position, and the blades are introduced at this point and are slid around the periphery in the grooves. This process is continued until the wheel is close-packed with blades, and the final blade is then locked in position to secure the assembly.

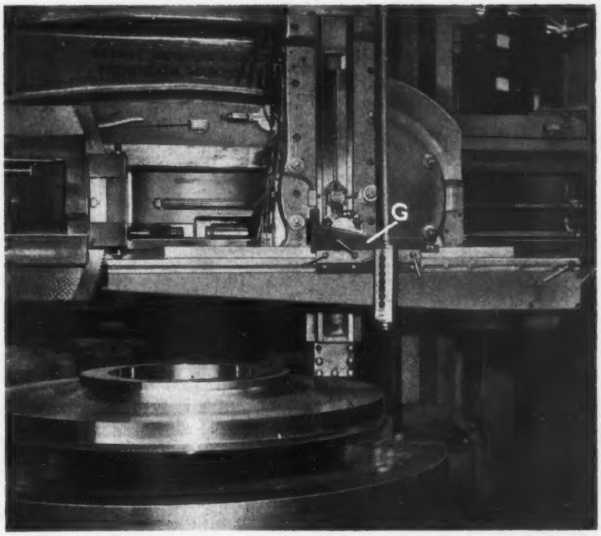


Fig. 8. On another Richards machine, turbine bucket wheels are copy-turned on both faces

It will be appreciated that the grooves in the wheel must be machined to within close limits for diameter, spacing, and form, and the various operations are carried out with the aid of special tooling. The tooling set-up was designed not only to produce wheels to the specified accuracy, but also to be used by semi-skilled labour, and has proved completely satisfactory. There are six pairs of special form tools in a complete set, and five pairs can be seen in Fig. 6, in the wooden box in which they are stored. The remaining pair of tools is seen in use in the close-up view Fig. 7, which also shows the lower end of the special tool-slide indicated at *B* in Fig. 5. This slide can be adjusted on the cross-rail of the machine, and carries at the lower end a special twin tool-holder, which is arranged for horizontal adjustment by means of the handwheel at the extreme left.

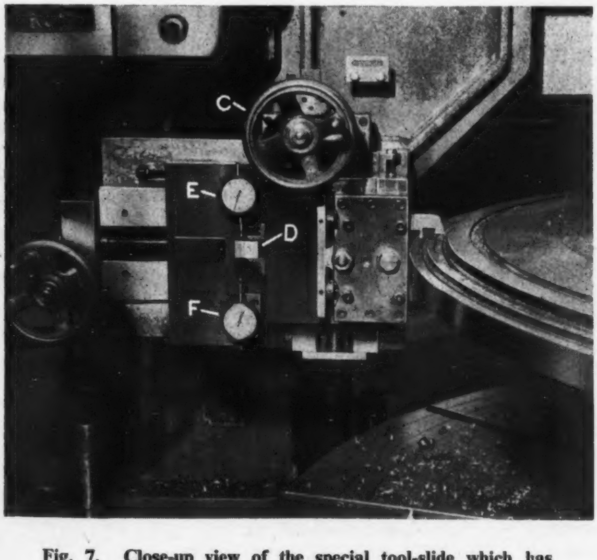


Fig. 7. Close-up view of the special tool-slide which has been provided on the Richards machine shown in Fig. 5

At the start of the operation, this tool-holder is set horizontally to a slip gauge, which is introduced between a ground face at the leading end and the periphery of the workpiece. Each of the tools is ground to a known length, from a datum face on the formed portion to the flat face at the opposite end of the shank, and is located in the holder by the latter face. For setting in the vertical plane, the tool-holder is raised and lowered by means of the handwheel *C*, which

turns a screw. At the rear of the tool-holder, there is a ground block *D*, and for machining the grooves in the under-side of the wheel (as in Fig. 7) the tool-holder is raised until the block *D* abuts the plunger of the dial indicator *E*.

Movement is continued until a predetermined reading is obtained on the dial *E*, which indicates that the tool in use has been fed to the required depth. For machining the grooves in the upper face of the wheel, the process is reversed, and the tool-holder is lowered until a predetermined reading is obtained on the indicator *F*. It will be appreciated that different readings are required on the two dials for the various pairs of tools, and the operator is supplied with a simple drawing and chart combined, giving scrap sections of each operation in the sequence. These small drawings are arranged in the order of operation, and the appropriate indicator readings and tool numbers—and any other relevant information—are appended. The wheel which is being machined in Fig. 5 is 6 ft. 1½ in. diameter by 11½ in. deep at the boss portion.

A neighbouring Richards machine, of the same type and capacity, is provided with electric copying equipment, and is employed for turning the faces of bucket wheels to the required form. A typical set-up is shown in Fig. 8, where the master template is indicated at *G*. It is carried on a cast-iron cantilever arm, supported from a bracket on the right-hand upright, and is arranged for longitudinal adjustment, to facilitate setting-up for diameter. The bucket wheel here shown is also 6 ft. 1½ in. diameter, and the operations performed at this set-up comprise turning each face and the periphery of the central boss, and boring the centre hole to within $\pm 0{\cdot}0005$ in. The machine has provision for maintenance of constant cutting speed—in this instance 200 ft. per min.—over the full width of the cut. A feed rate of $\frac{1}{32}$ in. per rev. is employed.

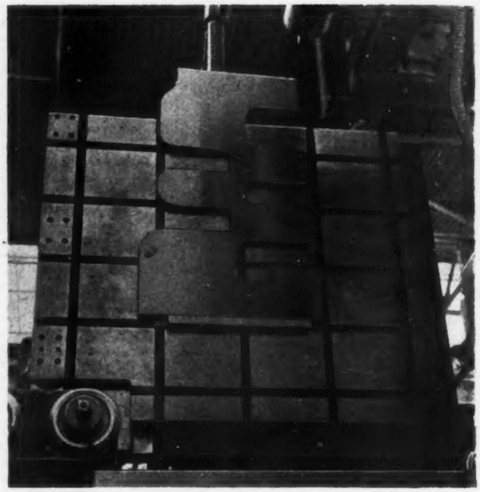


Fig. 10. Close-up view of the template employed for copy-turning the coupling seen in Fig. 9. The form at the right is for the external surface, and that at the left for the internal surface

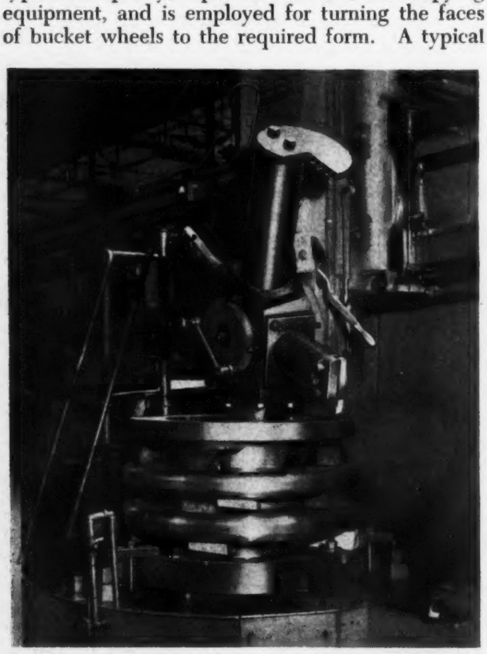


Fig. 9. The convolutions on this coupling for a low-pressure turbine are copy-turned, internally and externally, on this 48-in. Webster & Bennett vertical turning and boring mill

COPY-TURNING BELLOWS-TYPE COUPLINGS

Couplings for large turbine-generators afford another interesting example of copy-turning practice at the Larne works, and a typical set-up for one of these components is shown in Fig. 9. The machine is a 48-in. Webster & Bennett vertical turning and boring mill, of which a number is installed, and it is equipped for electrically-operated copying. Of 32½ in. outside diameter by 20 in. high, the coupling seen in position on the work-table is machined from a forged steel billet, which, when brought to the machine, has plain, parallel, internal and external surfaces. The bellows-type shape seen on the external surface is repeated in-

ternally, to provide a nominally constant wall thickness, and is produced under template control with the aid of a number of tools mounted in the turret.

A close-up view of the template is given in Fig. 10, where the form for the inside surface is seen at the left, and that for the outside surface at the right. An internal view of the coupling, showing some of the convolutions, is given in Fig. 11, where the turret has been raised to show the tool. This tool is slightly cranked, and is used for operations on the under-sides of the internal convolutions. There is a number of tools, of different shapes, which are used successively to machine various portions of the internal and external shapes. The coupling is first roughed-out completely, internally and externally, and is then stress-relieved prior to the finish-turning operations. After the operations have been completed, the plain portion at the lower end of the coupling, visible in Fig. 9, is gear-cut, to produce 57 teeth at 1·737 c.p. The wooden wedges seen driven between the external convolutions in Fig. 9 serve to damp-out vibrations during the operations on the internal surfaces.

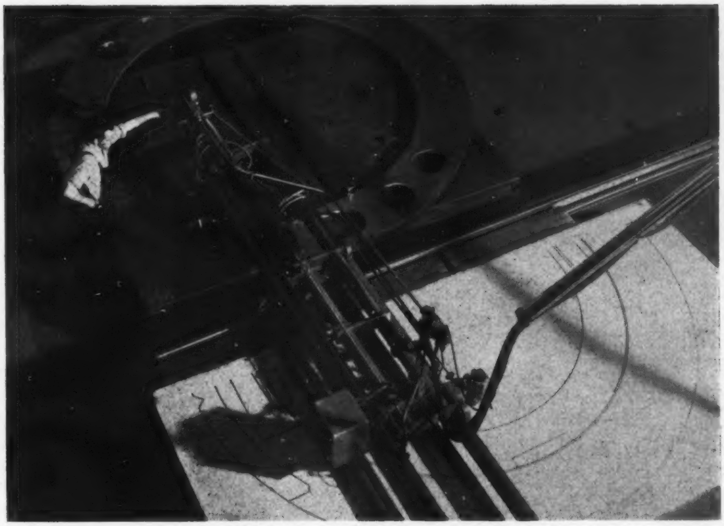


Fig. 12. Hancomatic flame-cutting machine set-up for operations on a stator ring. The machine automatically follows the drawing seen in the foreground

Fig. 11. In this view, the convoluted bore of the coupling shown in Fig. 9 can be seen

FACILITIES FOR FABRICATING

Ample space is provided for fabricating, by welding, large components, such as the stator housing seen in Fig. 4, and a wide variety of flame-cutting, plate-bending and similar equipment is installed. Equipment provided for plate-cutting includes a Hancomatic type HM 2B profiling machine [Hancock & Co. (Engineers), Ltd., Progress Way, Croydon], which has a working area of 62 in. by 120 in., and will cut workpieces from ⅛ to 15 in. thick. This machine operates under the control of a conventional drawing of the part required, and cutting is seen in progress on a typical workpiece—a large ring for a stator housing—in Fig. 12.

Mention may also be made of the facilities for annealing and shot-blasting. The annealing furnace is oil-fired, and will admit components up to 20 ft. square by 35 ft. long, with weights up to 70 tons. For shot-blasting, there is a room which will accommodate workpieces measuring 26 ft. 6 in. wide by 24 ft. high by 38 ft. 6 in. long, also with weights up to 70 tons.

NEW PRODUCTION EQUIPMENT

Edited by
G. W. Mason
and
A. J. Barker

Holbrook Type H No. 17 Precision Lathe

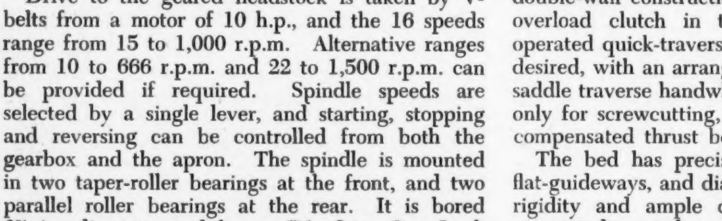
The type H No. 17 precision lathe introduced by the Holbrook Machine Tool Co., Ltd., Cambridge Road, Harlow, Essex, at the 1960 International Machine Tool Exhibition at Olympia, is now in full production. This lathe, which is shown in the accompanying figure, can be supplied with various alternative features to suit customers' requirements. It will swing 20 in. over the bed, and 11¼ in. over the carriage, and is normally supplied to admit 42 in. between centres. If required, a longer bed, to accommodate 66 in. between centres can be provided.

Drive to the geared headstock is taken by V-belts from a motor of 10 h.p., and the 16 speeds range from 15 to 1,000 r.p.m. Alternative ranges from 10 to 666 r.p.m. and 22 to 1,500 r.p.m. can be provided if required. Spindle speeds are selected by a single lever, and starting, stopping and reversing can be controlled from both the gearbox and the apron. The spindle is mounted in two taper-roller bearings at the front, and two parallel roller bearings at the rear. It is bored 2⅝ in. diameter and has a D1. 8-in. Cam-Lock nose. All the gears in the headstock are of nickel-chrome steel, hardened and profile ground, and are pump lubricated.

The totally-enclosed, quick-change gearbox provides 60 threads and feed rates which are selected by a dial and associated levers. Threads obtainable range from 1¼ to 76 per in., and the sliding and surfacing feeds from 0·0013 to 0·080 in. per rev. If metric pitches are frequently required, a direct change-over unit can be built into the gearbox as additional equipment to obviate the need for separate change gears. A reverse clutch, controlled by a lever on the apron, is provided for the screwcutting and feed motions. The apron is of double-wall construction and incorporates a safety overload clutch in the feed drive. A power-operated quick-traverse motion can be provided, if desired, with an arrangement for disconnecting the saddle traverse handwheel. The leadscrew is used only for screwcutting, and is fitted with the firm's compensated thrust bearing in the end bracket.

The bed has precision ground double-vee and flat-guideways, and diagonal bracing which ensures rigidity and ample clearance for swarf. It is supported on a base which houses the electrical equipment, also the coolant sump and pump.

All sliding surfaces of the carriage, except the top slide, can be lubricated at will by depressing a pump lever on the right side of the apron. A quick-withdrawal mechanism is incorporated to facilitate internal and external screwcutting operations, and automatic stops may be used for screwcutting, turning and boring. Multi-start threads are normally obtained by indexing the change gears, but an indexing plate can be supplied to give 60 positive settings.



Holbrook type H No. 17 precision centre lathe

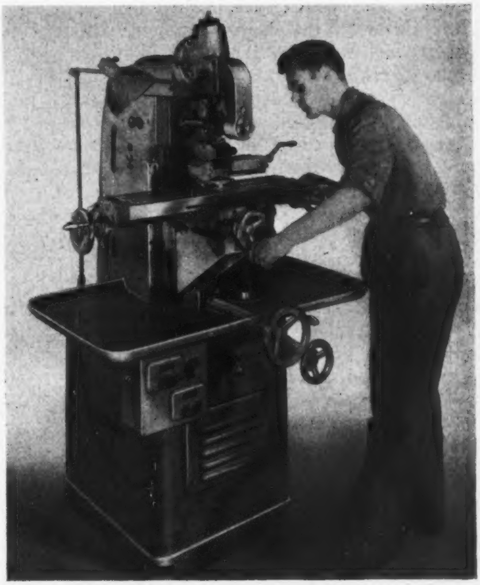
The heavy-duty tailstock can be set over for taper turning and the Morse taper centre is self-ejecting. For production work, a tailstock with a larger diameter barrel, with both fine and coarse feed motions, can be fitted.

Standard equipment for the lathe includes a square-turret top-slide, faceplate, 3-point steady, and a driving plate and driver. Other equipment that can be provided includes a taper turning attachment, a draw-in collet attachment, a sub-head spindle speed reducer for cutting coarse threads, a universal relieving attachment, a hob grinding attachment, and a spherical slide for concave and convex turning. Hydraulic copying equipment can be fitted, to enable internal, external and face profiling to be performed. For repetition work that requires the use of a number of tools, a top-slide unit, with quick clamping arrangements, can be fitted to take a range of precision, interchangeable, tool-holders.

The accuracy of the leadscrew and associated gear train on each Holbrook lathe is checked against a master screw certified by the National Physical Laboratory to be accurate for pitch within 0·0002 in. over a length of 6 ft. This master screw is mounted between the centres of the lathe and the test is carried out with the aid of a Taylor-Hobson Talymin electric stylus head in conjunction with a chart recorder, according to a procedure originated by the N.P.L., and to which reference has previously been made in MACHINERY.

Schaffner W.12 Universal Milling Machine

Dowding & Doll, Ltd., 346 Kensington High Street, London, W.14, have recently been appointed sole agents in the United Kingdom for the range of milling machines built by E. Schaffner, A.G., Schonenward, Switzerland, and an example is shown in the illustration. Designated W.12, this universal machine incorporates a 30- by 8-in. work-table, which is provided with a longitudinal traverse of 17 in.



Schaffner W.12 universal milling machine

Steplessly-variable feeds from $\frac{11}{16}$ to $5\frac{5}{8}$ in. per min. are obtainable for this motion. Lateral and vertical hand adjustments of $5\frac{5}{8}$ and $10\frac{1}{4}$ in., respectively, are provided, and stops to limit travel in these directions can be set accurately with the aid of graduated scales. The slides are mounted on hand-scraped ways, and movements are applied by means of hardened and ground screws.

Maximum and minimum distances of $13\frac{3}{4}$ and $3\frac{1}{2}$ in. are obtainable between the surface of the work-table and the axis of the horizontal milling spindle, also between the table and the spindle nose of the vertical head. The latter unit can be swivelled through 360 deg. about a horizontal axis, and is carried by a ram which is mounted in dovetail ways at the top of the column. With this arrangement, throat depths from $3\frac{1}{32}$ to 9 in. can be obtained for vertical milling, and the head can be retracted clear of the working area, to permit bulky components to be accommodated when using the horizontal spindle. The short, stiff overarm bracket is bolted to the outer face of the vertical head, and may be readily removed. Drive for the spindles is taken through hardened, ground and lapped gears, and the steplessly-variable speeds obtainable range from 45 to 2,640 r.p.m.

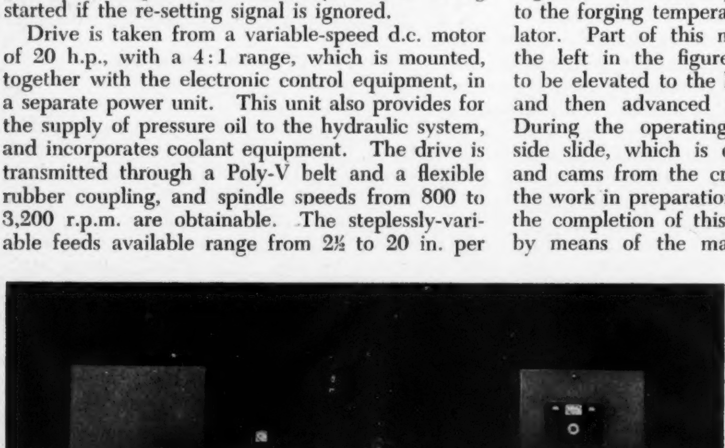
Equipment can be supplied for slotting and spiral milling, and a universal dividing head and an indexing work-table are also available.

Monarch Mona-Matic No. 21 Copying Lathe

Built by the Monarch Machine Tool Co., Sidney, Ohio, U.S.A., who are represented in this country by Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2, the Mona-Matic No. 21 copying lathe seen in the figure is intended primarily for turning stepped shafts. Surface finishes of approximately 40 micro-inches can be obtained, and it is stated that diameters can be held to within 0·0002 to 0·0004 in., depending on the workpiece length.

Movement is applied hydraulically to the copying slide under the control of an Air-Gage tracer head, which may be adjusted laterally. For controlling workpiece size, a ¾- to 5-in. capacity caliper gauge is brought automatically to the measuring position to check one diameter, with a frequency which may be pre-set at 1, 5, 10, or 20 operating cycles. Any error which is detected causes a signal to be transmitted to an electro-mechanical servo system, whereby a correcting movement is applied to the tracer head, and in this way, compensation is made automatically for tool wear. To prevent the continued use of a tool after the estimated permissible amount of wear has taken place, a counter is provided which may be set so that a signal lamp is illuminated after the completion of any predetermined number of operating cycles, up to 400. The operator then brings a fresh tool or cutting edge to the working position, and presses a button to retract the tracer head. Before re-starting production, a short trial cut is taken, and the turned surface is gauged, to enable the servo system to adjust the tracer head. Interlocking is provided, to prevent a fresh cycle from being started if the re-setting signal is ignored.

Drive is taken from a variable-speed d.c. motor of 20 h.p., with a 4:1 range, which is mounted, together with the electronic control equipment, in a separate power unit. This unit also provides for the supply of pressure oil to the hydraulic system, and incorporates coolant equipment. The drive is transmitted through a Poly-V belt and a flexible rubber coupling, and spindle speeds from 800 to 3,200 r.p.m. are obtainable. The steplessly-variable feeds available range from 2½ to 20 in. per min., and up to six different feeds and speeds can be pre-selected for automatic engagement, as required, during an operating cycle.



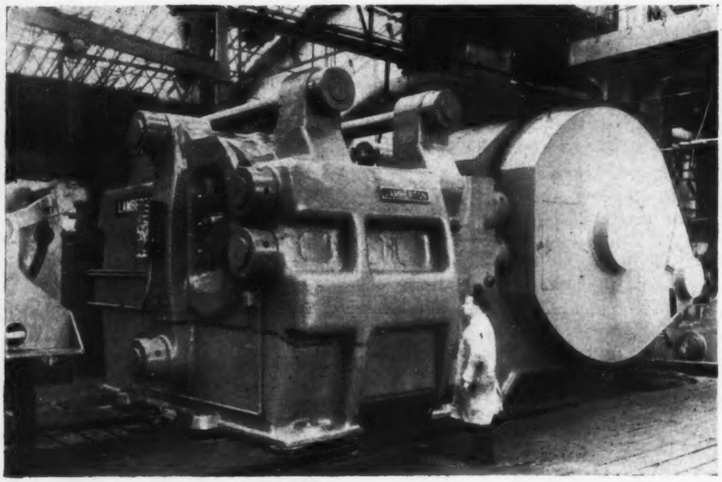
Monarch Mona-Matic No. 21 copying lathe

Lamberton Horizontal Forging Machine

Recently installed in the Mossend, Lanarkshire, tube works of Stewarts and Lloyds, Ltd., the horizontal forging machine here shown was built by Lamberton & Co., Ltd., Coatbridge, Lanarkshire, and provides for upsetting the ends of heavy steel tubes up to 10 in. diameter, as required for lining deep oil wells. During subsequent operations, male and female threads are cut at opposite ends of each tube, to permit lengths to be connected together without the need for coupling pieces. The machine is capable of exerting a force exceeding 2,000 tons, and has a total weight of approximately 300 tons.

Forging is performed in successive stages by a series of punches carried on the main slide, which is driven directly from a crankshaft. For the operation, a workpiece is transferred from a heating unit, in which a portion at one end is raised to the forging temperature, to rollers on a manipulator. Part of this manipulator can be seen at the left in the figure, and it enables the work to be elevated to the level of the first tool station, and then advanced into the working position. During the operating cycle, dies carried on a side slide, which is driven through toggle links and cams from the crankshaft, are closed to grip the work in preparation for the forging blow. After the completion of this stage, the work is lowered by means of the manipulator to the next tool station, where it is again advanced to the forging position, and this cycle is repeated until the entire sequence has been completed.

On account of its large size, the main frame of the machine is constructed in two pieces, one of which weighs more than 100 tons. The main and side slides are mounted in automatically-lubricated, anti-friction guides, and the former has a stroke length of 30 in. Drive to the crankshaft is taken from a 250-h.p. motor through V-belts and reduction gearing and a



Large Lamberton horizontal forging machine, for upsetting the ends of heavy steel tubes up to 10 in. diameter

single-operation multi-plate clutch. Both the clutch, and a disc brake which is also incorporated, were specially designed and made by the company, and are air-operated. They are arranged so that, in the event of failure of the air or electrical supplies, the clutch is automatically disengaged and the brake applied. Provision is also made for safeguarding the machine against overloading and misuse.

The sale of machinery built by Lamberton & Co., Ltd., is handled by the subsidiary, Eumuco (England), Ltd., 26 Fitzroy Square, London, W.1.

Iariston Tube Tapering Machine

The Addison Tool Co., Ltd., 28 Marshalsea Road, London, S.E.1, are the agents in this country for the Italian-built Iariston tube tapering machine shown in the accompanying figure. On this machine, tubes up to 2 in. diameter can be tapered by swaging, and additional equipment available includes special dies for doming the ends of tubes, and an attachment for forming tapers on bent tubes.

Die length may be 12, 16, 18, or 22 in., and it is claimed that the machine is particularly suitable for the production of components for metal furniture, bicycles, and motor cycles, for example. The tube to be tapered is introduced into the die either by hand or with the aid of a pushing device. Length of taper is controlled by adjustable stops, and sufficient clearance is provided to enable tapers in excess of the die length to be formed. Quick - action clamps and a special extraction device enable the dies to be rapidly changed.

The machine frame is a one-piece casting, and the spindle, which is of high-tensile steel, heat-treated and ground, is mounted in taper roller bearings. Drive is taken from an 8-h.p. motor, through six V-belts, and the flywheel runs at 330 r.p.m. Lubrication is provided by a motor-driven pump which draws oil from a sump in the base.

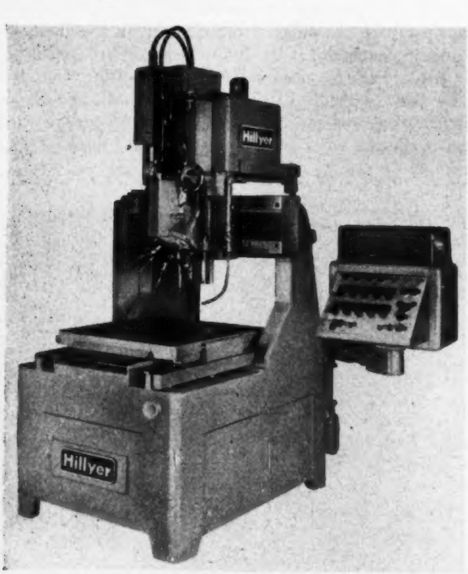
As an indication of the production capabilities of the machine, it is stated that a 2-in. diameter tube can be tapered to a point, over a 12-in. length, in 35 sec., and a 1-in. diameter by 16-gauge tube tapered over a 15-in. length in 6 sec., floor-to-floor time.

Iariston type 50 tube tapering machine

Hillyer Tape-controlled, Co-ordinate Drilling Machines

Shown in the accompanying illustration is an example from a range of tape-controlled, co-ordinate drilling machines, which has been introduced recently by the Hillyer Corp., Cranford, N.J., U.S.A. Boring, reaming, tapping, and straight-line milling can also be carried out, and it is stated that the accuracy with which the drilling unit is positioned laterally, and the table longitudinally, is such that hole centre distances can be held within 0·001 in. per ft.

Carried on an arm attached to the side of the machine, the control unit incorporates a tape reader. In addition there are dials whereby co-ordinate positions, and the spindle speed, feed rate and depth of feed for each station of the multi-spindle drilling head, can be set up by hand. When the machine is operated under automatic control, co-ordinate information is supplied by means of a punched tape, which also determines the drilling conditions for each station of the head. The tool at a given station can, moreover, be employed for producing holes of different depths at various stages during a cycle. Operating rates up to 15 holes per min. are claimed.

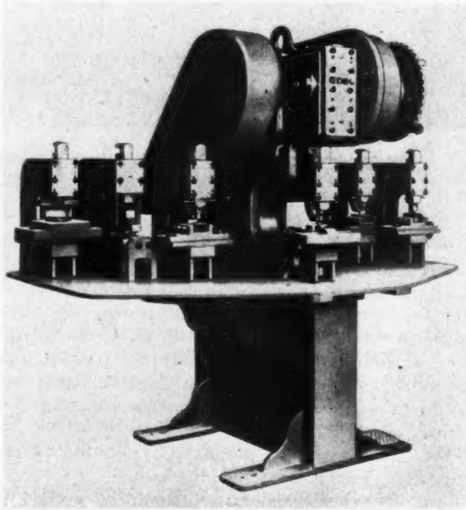


Co-ordinate setting of the drilling unit and the work-table, also selection of the speed, feed rate and depth for each spindle position on this Hillyer machine are controlled by punched tape

Either a 4-in. wide plastics or Flexowriter 1-in. paper tape can be used. Preparation is said to be simple, and with the former type, a hand-operated punch is employed to pierce the tape directly in a decimal form, no special training for the operator being required. A keyboard-type punch is used in the preparation of a Flexowriter tape.

Edel VM 35 Eccentric Presses, with Interchangeable Tool Units

Interchangeable, self-contained tool units, of the C-frame type, are employed with eccentric presses in the German-built Edel VM 35 range, which is marketed in this country by F. J. Edwards, Ltd., 359-361 Euston Road, London, N.W.1. A unit is retained in the working position by means of a lever-operated clamp, and with this arrangement, tool changing is effected rapidly, and the idle time when dealing with small batches, for example, is kept to the minimum.



Interchangeable, C-frame tool units, examples of which are here seen, are used on this eccentric press from the Edel VM 35 range

Units are available for piercing operations, and others can be supplied which incorporate punches and dies for shearing material of circular, rectangular, and other cross-sectional shapes, also for square and mitre notching. Cropping tools can be supplied, and special punches and dies can be provided, if required.

The range of presses comprises five sizes, with capacities from 35 to 100 tons, and throat depths from 7¾ to 13⅜ in. The frame is of fabricated construction, and the hardened and ground ram is guided by long, adjustable ways. Drive for the eccentric shaft, which runs in hard bronze bearings, is taken from a motor to a balanced flywheel, and thence through roller bearing-mounted shafts and totally-enclosed reduction gearing. A hardened and ground multi-tooth dog clutch is incorporated in the transmission system, and can be operated by a lever or a pedal. The range of extra equipment which is available includes feed units and precision length stops.

"Baby" Portable Bandsawing Machine

Recently introduced by Soag Machine Tools, Ltd., Juxon Street, London, S.E.11, the "Baby" portable bandsawing machine, here shown in use, weighs 21 lb. and has overall dimensions of 21½ by 7½ by 6¾ in. It has capacity for cutting circular-section bar up to 2½ in. diameter and sections with overall dimensions up to 4½ by 3 in., and as an example of the operating speed, it is stated that 1½-in. diameter mild steel bar is cut in 80 sec.

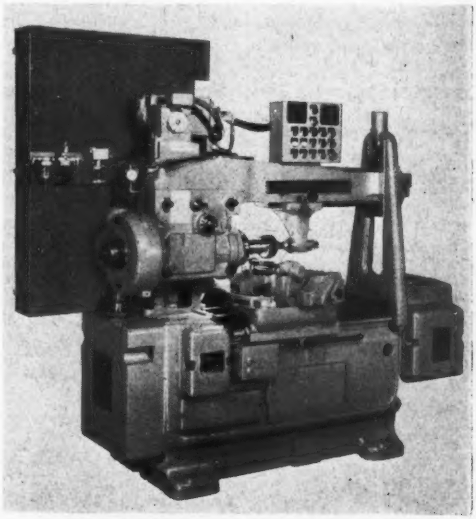
The high-speed steel blade is guided by two pairs of hardened steel rollers, and is kept under constant tension by a rack and pinion system. This tension may be readily released, for blade-changing. Drive is taken from a ⅛-h.p. motor through a train of six hardened helical gears, and the cutting speed is 115 ft. per min.

"Baby" portable bandsawing machine

Extra equipment available includes a stand, which enables the machine to be used vertically, in conjunction with a work-table, or horizontally. A swivel-type vice is employed for holding the work, with the latter arrangement, and the machine is pivotally-mounted at the front, and requires no attention while cutting is in progress.

Barber-Colman Multicycle Automatic Hobbing Machines

The Barber-Colman Co., Rockford, Ill., U.S.A., who are represented in this country by Barber & Colman, Ltd., Marsland Road, Brooklands, Sale,



Power vertical movement is provided for the work slide of this Barber-Colman No. 16-16 Multicycle automatic hobbing machine

Cheshire, introduced, at the Chicago Machine Tool Exposition last year, alternative Multicycle versions of their 16- and 6-in. hobbing machines. In the accompanying illustration is shown a No. 16-16 machine of the modified design, on which power feed and traverse is available for vertical movement of the work slide as well as for traversing the hob slide. With this system worm gears can be produced.

Movement of the slides is controlled by means of cams, which can be readily adjusted when setting

up, and three different automatic operating sequences can be obtained. With the "square" cycle, the conventional hobbing sequence is followed, with rapid approach of the work slide before machining begins, and subsequent rapid return of the hob slide to the starting position. The "plunge" cycle provides for rapid approach of the work slide, followed by the application of feed to bring the hob to depth, various rates being obtainable. For the "plunge-approach" cycle, the motions of these sequences are combined and the hob is very rapidly brought to the full depth at the start of the operation. Selection of the required sequence is made in a simple manner.

A considerable reduction of non-productive time is claimed, and it is stated that when the "plunge-approach" cycle is employed it is often possible to use larger hobs, with multiple starts. With such hobs, accuracy may be improved and machining time reduced.

Masterlap Twist Drill Grinding Attachment

Lester-Brown Machine Tools, Ltd., Bayton Road, Exhall, Coventry, have recently introduced the twist drill grinding attachment, shown in the accompanying illustration, for use with the Lester-Brown Masterlap grinding and lapping machine which was described in MACHINERY, 92/1307—30/5/58.

The attachment can readily be substituted for a table and stop arm which are normally mounted on the machine. A bracket, indicated at *A*, when fixed in position is inclined at an angle of approximately 25 deg. to the base of the machine, and the shaft *B* must be parallel with the grinding wheel spindle. For the latter setting, a special gauge is supplied with the attachment.

The twist drill to be sharpened is inserted in the attachment, located against a stop, and clamped between jaws. A scale, marked from 80 deg. to 160 deg., provides for setting the included angle of the drill point. Feed is imparted to the drill by a threaded sleeve at *C*, which has a circular scale marked in increments of 0·0025 in. The drill clamp is moved from the loading position to the grinding position by means of the ball-ended lever on the left of the attachment, and locked. Another lever, on the right, is employed to apply a rocking movement to the twist drill while grinding is in progress. The second lip is ground by unclamping the drill, turning it through 180 deg., reclamping it, and repeating the procedure.

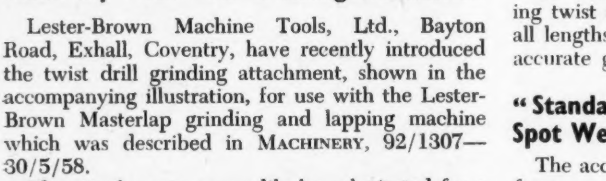
This attachment may be employed for sharpening twist drills of $\frac{3}{32}$ to $\frac{1}{2}$ in. diameter, with overall lengths of $2\frac{3}{4}$ to $9\frac{1}{2}$ in., and is stated to ensure accurate grinding of cutting and clearance angles.

"Standard" Sliding-head Spot Welding Machines

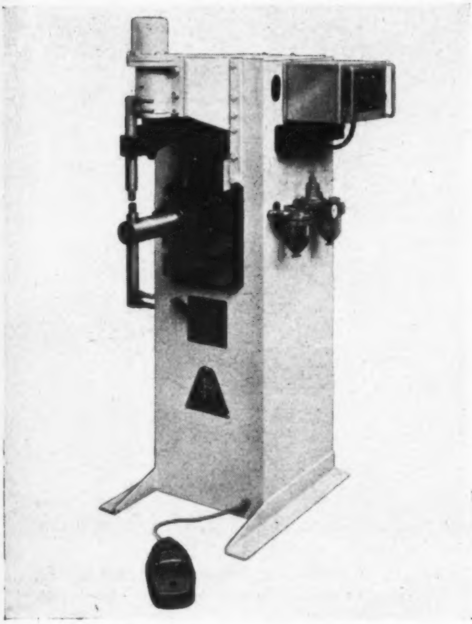
The accompanying illustration shows an example from a range of sliding-head spot welding machines which has been introduced recently by Standard Resistance Welders, Ltd., Endurance Works, Maypole Fields, Cradley, Staffs. Sizes are available with nominal ratings of 25, 35, and 50 kVA. for a 50 per cent duty cycle, and the machines, which are also suitable for projection and stitch welding, can be operated at rates up to 250 welds per min.

Provision is made for horizontal adjustment of the arms carrying the electrode holders, and the lower member is bored at both ends, to accommodate a holder either vertically or inclined at an angle of 20 deg. Vertical movement of the welding head is effected by an air system, which incorporates a pressure regulator and provides for exerting the maximum electrode tip force normally required with a compressed air supply at 80 lb. per sq. in.

The electrical equipment is arranged for connection to two phases of a 400/440-volt, 50-cycle, 3-phase



Twist drill grinding attachment for the Lester-Brown Masterlap grinding and lapping machine



"Standard" low-capacity sliding-head spot welding machine

supply, and the welding cycle is controlled by a 4-stage electronic timer, in conjunction with either an ignitron contactor or a contactor switch. Individual adjustment is provided for the durations of the various stages, and the ranges are from 3 to 20 and 15 to 100 cycles of the electrical supply for the "squeeze" and "weld" portions, and 3 to 50 cycles for the "forge" and "off" portions.

Provision is also included for either single or repetition operation. Welding current is supplied by a high-efficiency low-impedance transformer, and heat regulation is obtained by means of a 6-stage, off-load rotary switch.

Donovan CE 32 Proximity Switch

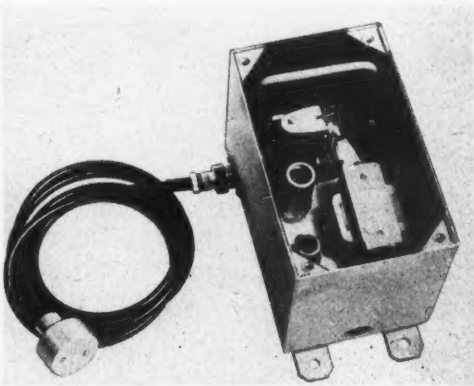
Now being made and marketed by Donovan Electrical Co., Ltd., Granville Street, Birmingham, 1, the CE 32 proximity switch has been used for some five years by Austin Motor Co., Ltd., for applications where a signal similar to that obtained from a limit switch is required, but where mechanical operation is not possible. It is of the inductive coupling type, and is thus unaffected by stray electrical fields, a characteristic that has permitted its employment in the vicinity of r.f. induction heating equipment.

The plug-in control unit is housed in a steel case measuring 7⅜ by 4$\frac{7}{16}$ by 5⅞ in. high, with a detachable cover, and may be connected to an electrical supply at either 250 or 400 volts a.c., satisfactory operation being possible with voltage fluctuations up to 20 per cent. A relay with change-over contacts rated at 5 amp. at 250 volts is normally incorporated, which provides for a maximum of 5 switching operations per sec. If a higher switching frequency is required, this relay may be omitted and the unit employed for feeding static switching equipment.

Completely sealed in a 1½-in. diameter by 1$\frac{17}{32}$-in. long head, the sensing coil is connected to the control unit case by a 6-ft. long cable. It will detect any metallic object which is passed at right-angles or parallel to the axis of the head, provided that it has a surface at least the same size as the projected area of the coil, and approaches to within about ⅜ in. of this member. The latter limit corresponds to a distance of approximately ¼ in. from the end face of the head assembly.

Swarf and metallic dust are not detected, and as there are no magnetic components in the head, ferrous materials are not attracted. The head can be completely submerged in coolant, for example, and a special type is available for detecting broken cutting tools.

The illustration shows the control unit with the cover removed, and the standard sensing head.



The Donovan CE 32 proximity switch provides a signal similar to that from a limit switch but does not require mechanical actuation

Wild-Barfield 2-station Induction Heating Machine

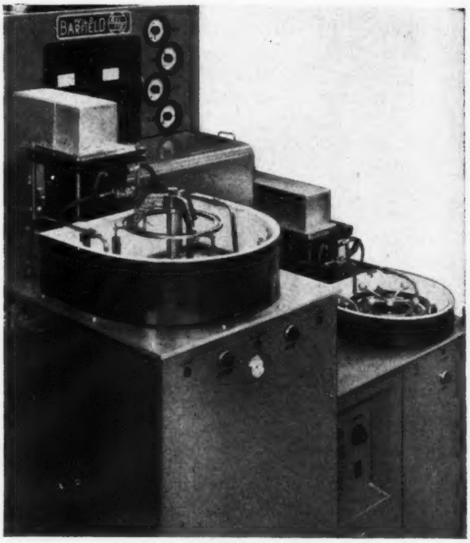


Fig. 1. Wild-Barfield 2-station induction heating machine, for hardening and tempering starter ring gears for motor cars and assembling them to flywheels

FOR HARDENING AND TEMPERING starter ring gears for motor car engines, and assembling them to flywheels, Wild-Barfield Electric Furnaces, Ltd., Elecfurn Works, Otterspool Way, Watford By-Pass, Watford, Herts., have recently supplied to an Australian factory the 2-station semi-automatic induction heating machine shown in Fig. 1. With this machine, it is stated work of consistent quality is obtained with an unskilled operator, and the need for subsequent cleaning is avoided.

Hardening is carried out at the left-hand station, where there is a spider carrier, with downwardly-inclined arms, mounted at the upper end of a vertical shaft. In operation, a fresh ring gear is placed over these arms by hand, and is pressed downwards, to engage with spring-loaded clamps at the lower ends. The automatic working cycle is then started by means of a push-button, whereupon the carrier is lowered for a short distance, to transfer the work into the plane of the single-turn heating coil. By means of this coil, the entire circumference of the gear is raised to the hardening temperature simultaneously, to reduce risk of distortion. To provide for uniform heating, drive for rotating the work is engaged at the beginning of the cycle, and continues throughout the pre-determined duration of the heating stage. At the conclusion of this stage, rotation is stopped, and the spider is again moved downwards, to lower the work into the quenching oil which is normally contained in the tank surrounding the working area. Finally, the carrier is returned to the original position, in readiness for unloading.

A close-up view of the fixture at the right-hand station is shown in Fig 2, and it will be seen that a large circu-

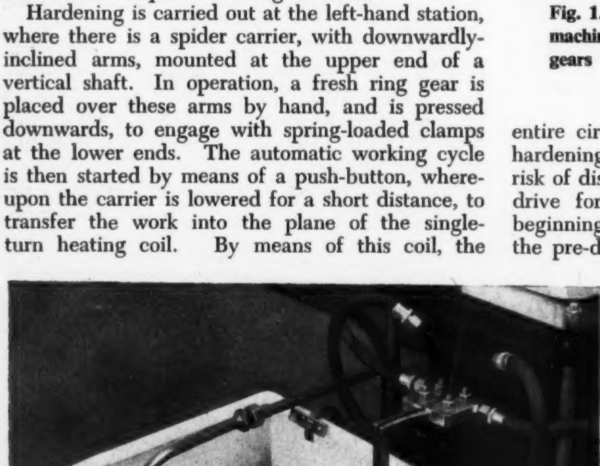


Fig. 2. Close-up view of the right-hand station, where the sequence of operations performed comprises heating the gear for tempering, inserting the flywheel, and quenching with water, which is sprayed from a ring distributor

lar clamp *A* is provided, the hub of which incorporates capstan handles and is mounted on the threaded upper end of a central, vertical spigot. Prior to loading the work, the spigot is moved axially, to a position somewhat higher than that shown in the illustration, and the entire clamp assembly is removed. The hardened ring gear is then transferred by hand from the first station, and is located by the bore against the sides of pins, which project from the upper end faces of short cylindrical pillars, arranged in a circle, as seen at *B*. Next, a flywheel is loaded on to the spigot, which locates it radially, and the clamp assembly is replaced and tightened down, to secure the component against a shoulder.

During the automatic cycle at this station, which is also initiated by push-button, the ring gear is first heated to the tempering temperature by the encircling single-turn induction coil *C*. After a pre-determined period, the heating current is switched off, and the spigot is then moved downwards, to enter the mating diameter on the flywheel into the bore of the ring gear. Next, water is sprayed from a distributor ring mounted directly below the induction coil, to quench the gear and simultaneously shrink it on to the flywheel. Finally, the spigot is returned to the original position, in preparation for unloading the completed assembly.

Power for the induction coils is taken from separate high-frequency transformers, which are supplied by a Wild-Barfield AHF 25-kW. generator. An automatic, 2-station switching system is incorporated, whereby the generator is kept in continuous use during the cycle of operations, and there are four process timers, for controlling the various stages. To maintain the quenching oil at a constant temperature, it is circulated by a pump through a system which incorporates thermostatically-controlled immersion heaters and coolers.

Drivmatic Automatic Riveting Machines

The General-Electro Mechanical Corporation, Buffalo, New York, U.S.A., have supplied to the U.S. aircraft industry a wide variety of Drivmatic drill-riveting machines for automatically assembling both headed and slug-type rivets. This company also make automatic and semi-automatic work positioners.

An interesting Drivmatic installation is shown in Fig. 1. This equipment is in use at the Long Beach, California, plant of Douglas Aircraft Co., Inc., and incorporates tape control. It is designed to rivet, automatically, 31-ft. long fuselage panels for DC-8 Jetliners. The panels are mounted in a 40-ft. long frame which, during riveting, moves on a 90-ft. long floor track. Tack rivets, spaced at 5-ft. intervals, are used as synchronizing points when the machine is being operated under automatic tape control.

The operator at the control panel cannot see the riveting ram behind the fuselage panel, and a closed-circuit television system, with two cameras and two monitors, is provided to enable the alignment of the ram with the tack rivets to be checked,

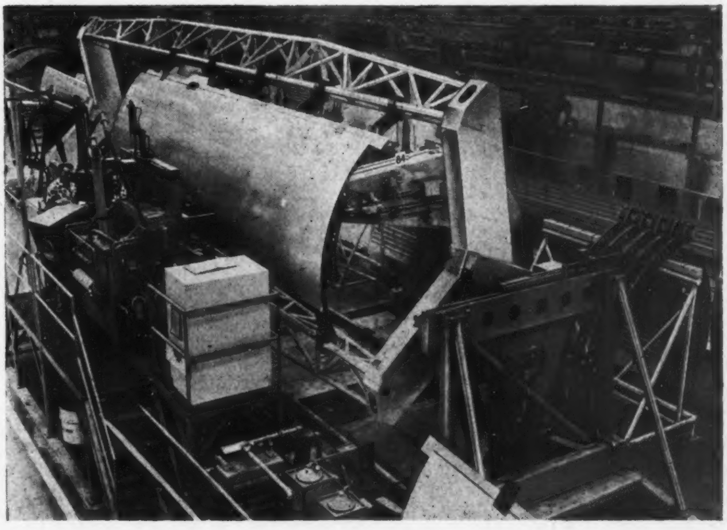


Fig. 1. Drivmatic automatic riveting machine installed in the Douglas plant for riveting fuselage panels for DC-8 Jetliners

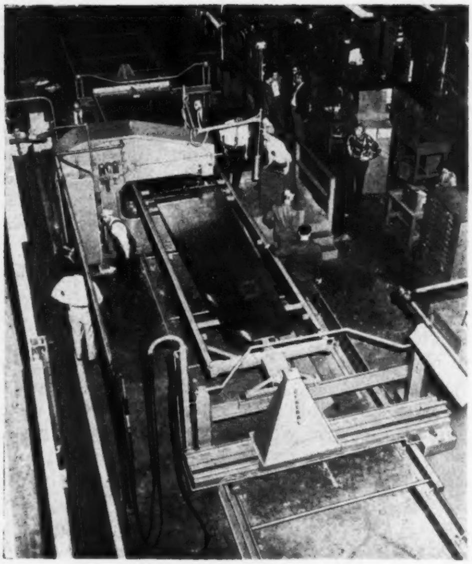


Fig. 2. Drivmatic automatic riveting machine for DC-8 Jetliner wing panels

and to permit the work table position to be adjusted manually, if necessary. During the automatic cycle, the operator can continuously check the machine alignment by reference to the screen. The television system was supplied by TelAutovision Closed Circuit TV, Division of TelAutograph Corp.

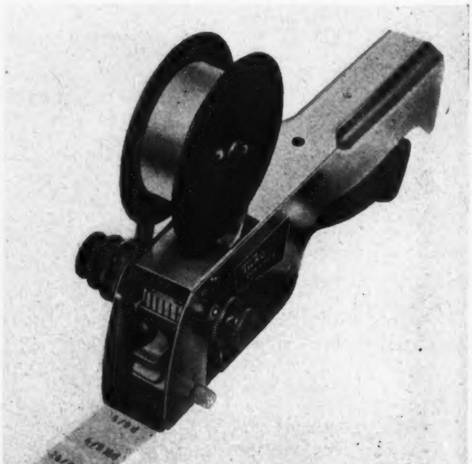
Another Drivmatic machine, shown in Fig. 2, which is also installed in the Douglas plant, is employed for riveting ¼-in. thick aluminium skin panels to extruded stringers on 9- by 47-ft. wing sections, which may require as many as 8,500 rivets. The operations performed comprise drilling the hole, countersinking, setting the rivet, heading, and shaving off the top of the head flush with the skin surface. Table motions are controlled by tapes with square punched holes which allow switches, associated with drive clutches, to operate. There are three tapes, one of which controls the longitudinal motion corresponding to the pitch of the rivets in a row. The other two tapes, one for each end of the table, control the transverse motion, and enable the table to be swivelled to produce rows of rivets that are straight but not parallel to each other. These transverse tapes also control a table tilting mechanism which ensures that the rivets are driven at right angles to the curved top surface of the work. The longitudinal tape also initiates the cycle of the riveting head, and upon completion of this cycle, the next tape-controlled traverse motion is started. For the combined riveting and work positioning cycle, 30 sec. is required. The throat depth of the machine is 8 ft., and provision is made for swivelling the work through 180 deg. in the horizontal plane so that wide wing sections can be riveted in two stages.

Automation, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11, are sole agents here for the General-Electro Mechanical Corporation.

Tickoply Mini Labelling Tool

For the rapid labelling of parts, with batch numbers, for instance, the Tickoply Mini automatic ticket printing and labelling tool has been introduced by Tickopres, Ltd., 7-8 Old Bailey, London, E.C.4. This unit prints and affixes a self-adhesive ticket in one operation.

In use, the readily-adjustable dials that protrude from the sides of the tool are set, and the lever-type grip below the handle is depressed to print the selected digits on the leading ticket of the reel. Release of the grip causes the printed ticket to be advanced, and the backing paper over the pressure-sensitive adhesive to be partially removed. The ticket is then placed against the surface to be labelled, and, finally, the tool is withdrawn with a downward movement.



Tickoply Mini labelling tool

L.T.E. Chiswick Works

EXTENSIVE RE-ORGANIZATION, at a total cost of £1,250,000, has recently been undertaken at the Chiswick works of the London Transport Executive, which are concerned solely with the overhaul and repair of the principal mechanical and electrical units of motor buses of both the single and double-deck types.

To enable quantity methods to be employed in connection with this work, the number of different types of vehicles has been reduced to a minimum, and the shops are arranged for flow-line operation. At the same time, flexibility has been preserved to provide for introduction of new designs, for which different tools and equipment may be required. For example, electrical power supplies to all machines are taken from an overhead bus-bar system, to facilitate any re-arrangement that may be desirable. Handling has been carefully studied, and wherever practicable conveyors are provided. There is also extensive overhead lifting equipment. Stacking pallets are employed for external transport of complete units, and they are moved within the works by special trucks.

There are now 1,300 production workers in the factory, and an output of nearly 2,000 overhauled mechanical units is obtained weekly. The rate at which individual units are received is unpredictable, and may vary considerably from week-to-week, and it is therefore necessary that the employees should be capable, within particular fields, of undertaking a variety of different operations.

OVERHAUL AND REPAIR METHODS

Units are delivered by lorry, and for the most part—with the exception of batteries—are transferred to wheeled trucks, and are then passed to the adjacent stores, where those of identical types are marshalled into batches.

From the stores, units which require special consideration, such as brakes, fuel pumps, and electrical equipment, are passed directly to individual shops, which are virtually self-contained. The principal units are subjected to a similar pattern of treatment, and in view of the condition in which they are received, ample provision is made for external cleaning prior to dismantling. Further cleaning may be carried out during stripping, if necessary, and all components of these units are then passed to a continuous machine through which they are carried by a flight bar conveyor. In this machine, the work is sprayed first with heated metasilicate solution, and then with heated soda solution for rinsing. Subsequently, a final cleaning treatment is carried out in tanks which are served by 1-ton overhead travelling cranes. Other facilities provided include booths wherein the work is blasted with nut shells, for example, in preparation for crack detection, and a buffing machine. For the removal of rust from the interiors of air receivers for braking systems, which are first degreased in a hot alkaline fluid, quantities of a chemical composition and steel balls are placed inside, and the components—three

Fig. 1. A view in the welding section showing one of the positioners which was designed and made in the works. Heating is provided by a gas muffle ring

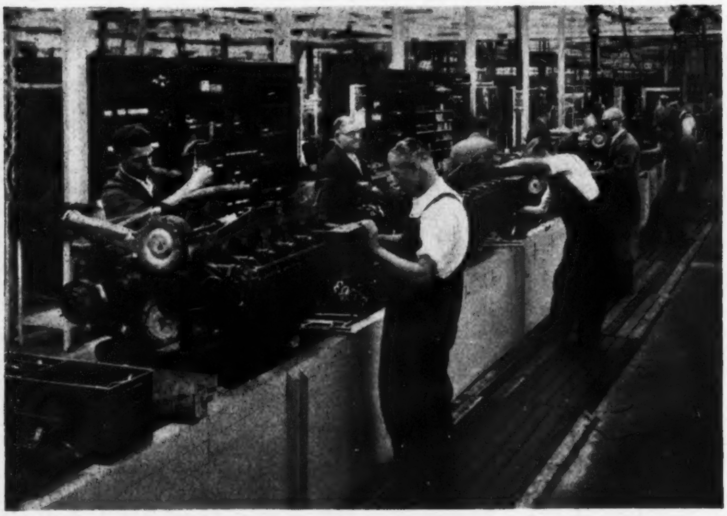


Fig. 2. The engine assembly conveyor is 128 ft. long. Two operators complete each engine, moving with it as it travels along the conveyors

and can be tilted by means of a large handwheel. The work-table can also be rotated, by means of a treadle, to facilitate building-up poppet valve seats, for example. Preparation for welding, and subsequent fettling, are performed in an area adjacent to the welding shop, where shot blasting equipment and two booths for metal spraying are also provided. In these booths, for example, all road wheels are zinc-coated, to prevent tyre adhesion.

There are 127 machine tools in the general machine shop, which are arranged, for the most part, according to type. A small flow line has, however, been established on which worn liners are pressed out of cylinder blocks, and fresh liners inserted. The latter are then bored and honed to a surface finish of 35 to 40 micro-inches. Cutting fluid is supplied to the eight fine boring machines in this line from a centralized, underground tank.

Repaired parts are delivered to one or other of two stores in readiness for re-assembly, and owing to the high standards maintained, interchangeability is ensured. In these stores, also, parts which are unsuitable for building-up, and have consequently been re-conditioned by machining to one of three smaller sizes, are matched with suitable mating components. From one of these pre-assembly stores, components are issued to serve an area in which sub-assemblies for engines are built up, and then passed to a further stores. The final assembly of engines is performed on a 128-ft. long conveyor, as seen in Fig. 2, on which supporting cradles are mounted at intervals of 9 ft. 6 in. This conveyor travels at a speed of about 3 in. per min., and each engine is assembled entirely by a pair of operators, who follow, working on opposite sides of the conveyor. Components are taken from racks seen in the background, located at the required positions.

Before being released for service, each engine undergoes a test run. As a result of developments at Chiswick and other establishments, it has been possible, during the past ten years, to reduce the

per load—are then tumbled for 1 hour in a special machine, designed and built in the works.

From the cleaning shop, parts for inspection are passed to an adjacent area, where measuring and gauging equipment is provided, also machines for crack detection by the magnetic and fluorescent ink methods, and rigs for water testing cylinder blocks and heads. Parts which require repair are passed directly to an adjoining control stores, where they are marshalled into economic batches, for issue to the repair shops.

Facilities for the recovery of worn parts include a plating shop, with 5 baths for nickel deposition and 4 baths for chromium. In the latter a deposit with a hardness of 800 to 900 D.P.N. is obtained at the rate of 0·0016 in. per hr.

For building-up and repair by welding, oxy-acetylene and electric equipment is housed in a ventilated area. An oven is provided, for preheating heavy components, and among a number of heated and unheated stands where gas welding is carried out, attention may be drawn to the positioner shown in Fig. 1, which was designed and built in the works. On this positioner, the work is supported by a table inside the muffle ring, a gap in the latter affording access for welding, and heat is provided by a number of gas jets. Hinged arms are incorporated, to retain the work on the table, and the entire unit is pivoted on a horizontal shaft mounted on the fabricated frame,

number of employees engaged in bus overhaul, maintenance, and servicing, from 1·5 to 1·13 per vehicle. At the same time, the number of spare buses held to cover maintenance and other needs has been reduced from 9 per cent to 5 per cent of the fleet, and there has been a 17 per cent reduction in total costs per mile run for bus overhaul and maintenance.

English Electric Quality Control System for Sheet Metal

A new quality control system for the sheet steel and tinplate industries, introduced by the Metal Industries Division of the English Electric Co., Ltd., English Electric House, Strand, London, W.C.2, involves the use of a classifier for sorting sheared sections of cold rolled strip and rejecting faulty pieces. Faults such as pinholes, errors in gauge, and poor surface finish are detected during the inspection of the continuous strip, but sorting into grades can only be carried out when the strip has been cut into individual sheets. The sheet classifier stores the information concerning strip quality which was obtained at the time of inspection, and uses it when the cut sheets are being sorted into piles. Information is stored and processed by standard transistorized logical elements known as Datapacs.

From these standard elements, a sheet classifier system of any size and complexity can be built up, for a line operating at any speed, to cover cut lengths with a ratio of as much as 10/1. The first units will shortly be installed on No. 5 cut-up line at the Abbey Works of the Steel Co. of Wales, Ltd., and on two cut-up lines at the works of Richard Thomas & Baldwins, Ltd., at Ebbw Vale. A further unit is to be installed in a South African steelworks.

At the Abbey Works, the classifier will be used in conjunction with a line operating at 700 ft. per min., for cut lengths ranging from 40 to 180 in., and the material will be sorted into rejects and prime sheets. On two tinplate lines at Ebbw Vale, both operating at 1,000 ft. per min., and with cut lengths ranging from 18 to 42 in., there will be four classifications, namely sheets with pinholes, off-gauge material, other rejects, and prime sheets.

The accompanying illustration shows, diagrammatically, the arrangement of a typical system. Datapac standard logical elements are in the form of standard plug-in packages. Each package contains a number of elements capable of performing specific logical functions, and each element can operate from the output of the preceding element, so that a series can be arranged to form any desired logical system.

Faults detected by the instruments are stored in the first shift register at a point corresponding to the instrument position. Shift pulses in time with the conveyor movement are applied to the register so that the fault signal moves within it in time with the movement of the faulty section of strip on the shearing line. The signal transfers from the register to "store 1" when the fault passes the shear position. This signal then indicates that the next sheet to be cut is a reject.

When the sheet is cut, the operation is detected by a device which causes the signal to be transferred from "store 1" to "store 2", and this transfer indicates that the last sheet cut is a reject. The leading edge of this reject sheet is now detected by one of the leading-edge detection

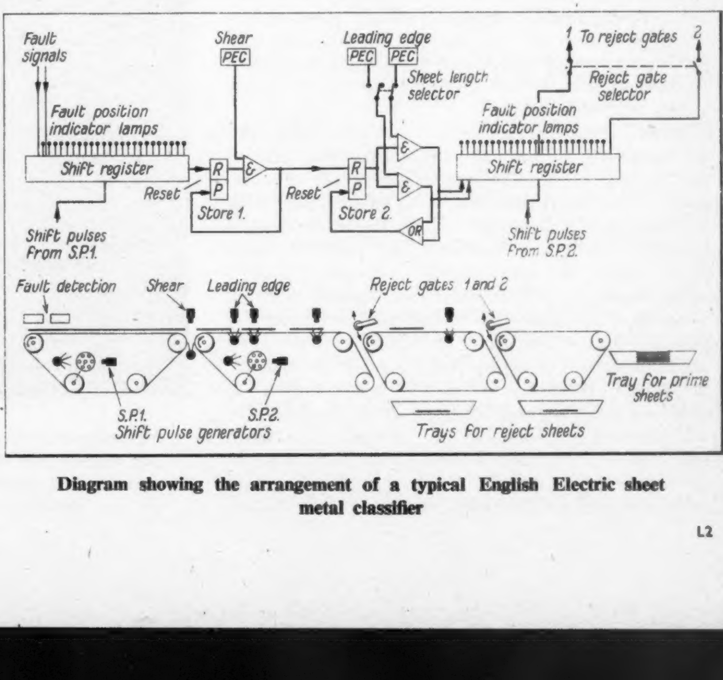


Diagram showing the arrangement of a typical English Electric sheet metal classifier

photocells and the signal is transferred to a suitable position in the second register. Subsequently, this signal is shifted within the second register, so that it appears at a reject gate just before the leading edge of the sheet reaches the gate. Finally, the signal is used to instruct the gate control to reject the sheet when its leading edge reaches the gate photocell.

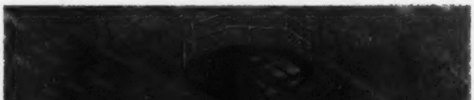
Two leading edge photocells are provided after the shear to cover the range of sheet lengths. One is employed for short sheets, the other for long sheets. Either photocell is suitable for sheets of medium length. Selection of the photocell is effected automatically by the shear cut length setting. Normally, mechanical reject gates are used, but more complex methods, such as overhead magnetic conveyors with variable drop off points at the pile positions, can be provided if required.

Reactor Refuelling Machine

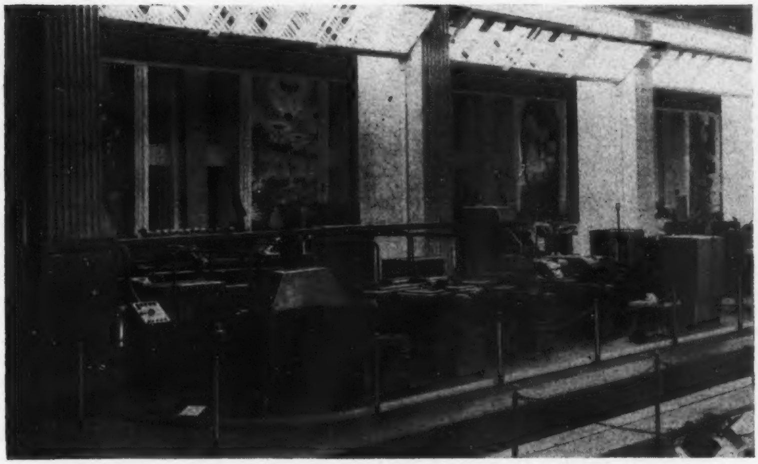
To provide for removing and replacing fuel elements for the advanced gas-cooled reactor at Windscale, John Brown (S.E.N.D.), Ltd., have designed, in conjunction with the Atomic Energy Authority, a machine which enables this operation to be performed while the reactor is under full load and pressure. Measuring 61 ft. high, and weighing approximately 400 tons, the machine is shown in the accompanying figure in the final stages of erection in the works of Markham & Co., Ltd., Chesterfield. It will subsequently be dismantled, for transportation to the site, where it will be erected above the reactor, which incorporates 253 vertically-mounted branch refuelling pipes. Provision is made in the design for reducing the machine to units which can be passed through a 10-ft. diameter air lock, by which access is gained to the reactor building.

Handling of the elements is usually carried out by means of a "normal" pressure vessel, and at the beginning of a refuelling operation, a nosepiece is extended downwards to effect a seal with the selected branch pipe. The spent element is then hoisted into a chamber in a 3-position magazine, which is subsequently indexed about a vertical axis, to permit the fresh element—carried in another chamber—to be lowered and locked in position in the reactor. The third chamber can accommodate a stand-by seal plug for the reactor. A second pressure vessel contains another 3-chamber indexing magazine, which is employed for withdrawing and housing the portions of a spent fuel element that has broken. Provision is made for viewing the operation through closed circuit television, and a CO_2 cooling system is incorporated, to ensure continuous removal of heat from the spent elements prior to disposal.

For co-ordinate positioning within the area occupied by the ends of the charge tubes, the structure supporting the pressure vessels is mounted on a wheeled crab, which in turn, is carried by a wheeled gantry. Initial setting is made under manual control, at a traverse rate of about 10 ft. per min., and the final positioning is performed entirely automatically. During the latter stage, the distance from the selected pipe, and the direction in which movement is required, are detected by sensing units carried in the nosepiece of the magazine in use, which is lowered for measuring purposes. Motion is applied at a rate which varies according to the approach distance, under servo control, and it is claimed that steady movement is obtained at speeds down to 0·006 in. per min. The accuracy of the entire traversing system is such that during recent tests, positioning was effected to within 0·002 in. The electrical control equipment incorporates extensive interlocks, to ensure that each stage of a refuelling operation is completed before the next can be initiated.



Measuring 61 ft. high, and weighing about 400 tons, this machine will be employed for removing and replacing fuel elements while the Windscale gas-cooled reactor is under full load



A Russian Automatic Transfer Machine Shown at the Leipzig Fair

By R. E. GREEN, Associate Editor

IN EARLIER ARTICLES IN THIS SERIES* reference has been made to some of the more interesting machine tools shown by the East German industry at this year's Leipzig Spring Fair. Three further articles† have been concerned with the range of standard machine tools exhibited in the Russian pavilion, and with an automatic in-line transfer machine for operations on oil filter housings. This latter machine, of the platen-fixture type, provides for a series of drilling, counterboring, boring, facing and tapping operations on aluminium-alloy housings, which are completed at the rate of 1 per min.

In addition, a second in-line transfer machine, of similar size, was shown. This machine, a general view of which is given in the heading illustration, has been built for operations on cast iron bearing caps for diesel engines. Like that already described, the bearing cap machine was designed and built by the Ordzonikidze Machine Tool Factory in Moscow, and it is designated ID 107. With a cycle time of 44·5 sec., the machine has an output of 65 sets of bearing caps per hour at 80 per cent efficiency, each set comprising five caps.

* MACHINERY, 98/939—26/4/61, 98/1006—3/5/61, 98/1074—10/5/61 and 98/1119—17/5/61.

† MACHINERY, 98/1193—24/5/61, 98/1251—31/5/61 and 98/1293—7/6/61.

MACHINE LAYOUT AND OPERATING SEQUENCE

In the heading illustration, the machine is shown with the loading end at the left, and it has a total of eight stations at which machining operations are performed. There are 13 unit heads, from the standard range produced by Ordzonikidze, for milling, drilling, spot-facing and tapping operations, and the total number of spindles is 85. Power is supplied by 25 separate motors, including those for the floor-mounted hydraulic pump units.

Examples of the one-piece cluster castings from which the bearing caps are machined are seen in Fig. 1. In accordance with current practice in Western countries, the casting provides a complete set of caps, and as much machining as possible is completed prior to separation, as shown by the example in the right foreground. The block is then cut into five separate bearing caps, as seen to the left, at the final station of the machine, which are discharged on a conveyor. Because the

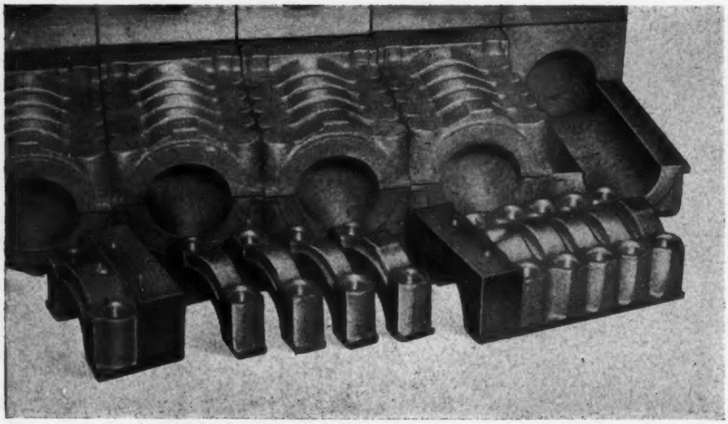


Fig. 1. The cluster casting, at the right, from which the five diesel engine bearing caps (left) are machined, measures about 8·25 by 5·25 by 2·5 in., and is delivered to the transfer machine with the long sides and half bore already milled

machine was operated only intermittently at Leipzig, certain of the machining stations were photographed without castings in position. After a few sets of caps had been produced, the cutting-off stations was rendered inoperative, and partly-machined castings were then recirculated.

Before being delivered to the transfer machine, each block casting is faced on the two long sides and on the joint surfaces, and the half bore is machined to a diameter of about 3 in. In this condition, each casting measures about 8·25 by 5·25 by 2·5 in. After machining has been completed, each small cap is 1 in. thick, and the end caps are 1·25 and 2·75 in. thick respectively. Holding-down bolt holes in each cap are drilled to approximately 0·56 in. diameter, and are countersunk at the joint face and spot-faced at their outer ends. Bearing retaining slots are milled in each cap, and the larger end cap also has two oil seal grooves in the half bore.

TRANSFER ARRANGEMENTS

Only one operator is required for the machine, and his duties are confined to feeding castings to the first transfer position, and general supervision. There are four separate transfer bars on the machine, as indicated in the diagrammatic plan view in Fig. 2, to provide for various machining station arrangements, and the first bar serves only the first machining station and the drum-type turn-over unit beyond. This bar is seen at *A* in the close-up view of the first machining station in Fig. 3, and it comprises two lengths of L-section steel, held apart by spacers to accommodate the spring-loaded pawls whereby the castings are moved along the transfer track.

Suspended and guided on rollers at each side, above the centre of the transfer track, the bar is connected to the ram of a hydraulic cylinder *B*, secured to a bracket within the turn-over unit housing. The transfer track served by this first bar has an initial portion, at the right in Fig. 3, with rollers on which the fresh castings are placed

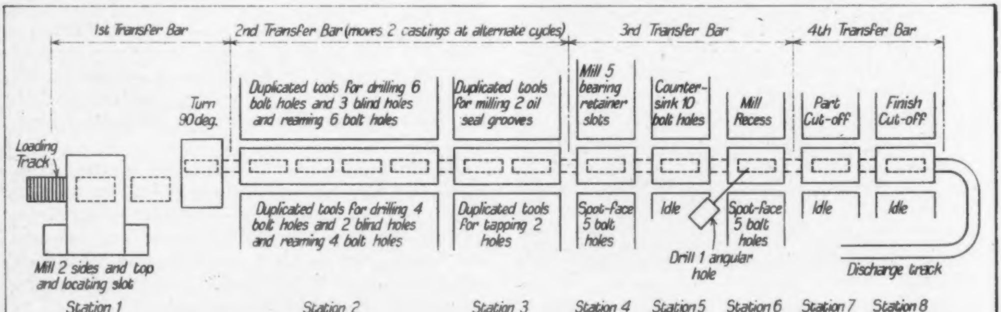


Fig. 2. Diagrammatic layout of the Ordzonikidze transfer machine for operations on diesel engine main bearing caps showing the arrangement of the machining stations and the four transfer bars

by the operator and pushed up to a spring-loaded stop. As the transfer bar moves towards the camera, during the machining cycle, the stop is automatically retracted upwards by a cam on the bar, and at the next transfer movement, the casting is carried to the first machining station.

The transfer track has a central tenon to guide the casting, which is loaded, initially, with the half-bore downwards and the large bearing cap leading. At the first machining station, the transfer track is formed by surfaces on a hydraulically-operated slide *C*. This slide forms the table of the first milling unit and is carried on a bed unit at right angles to the track. When this slide is moved to the position shown, the surfaces are aligned with the remainder of the track, and the operation of the transfer bar moves the casting on to the slide. The transfer bar has a fixed stroke which serves to position the casting roughly in the longitudinal direction, and final location is ensured by an inclined cylinder *D*, above the loading station.

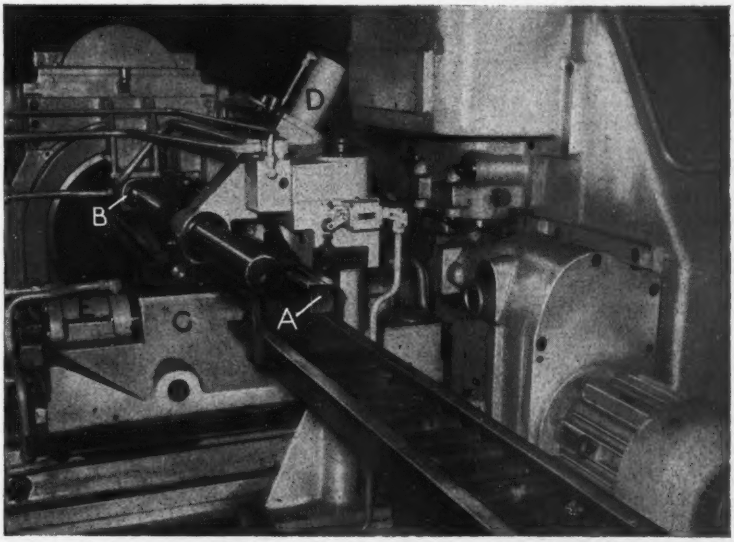


Fig. 3. At the loading station of the bearing cap machine, the casting is moved into a portion of the transfer track carried on a slide, clamped, and fed transversely to the milling cutters on the housing at the right

The ram of this cylinder carries a wedge-shaped plunger which is inserted between two of the curved outlines of the small bearing caps, in the top face of the block, when the cylinder is actuated. Centrally-pivoted, lever-type, clamps of T-shape are then applied to the holding-down bolt bosses at each side of the casting by the action of hydraulic cylinders on the slide, as at *E*.

MACHINING OPERATIONS

With the clamps applied, the slide is fed to the right, away from the transfer track, and the casting is carried past the milling heads, which are secured to faces on the massive bridge casting, clearly seen near the left in the heading illustration. There are three somewhat similar spindle heads, with separate driving motors, for facing operations, and a fourth head, within the bridge opening, machines a 0·25-in. wide, locating slot in the edge of the joint face of the smaller end cap. The face-milling head above the slide has two spindles and each side head one spindle, and all the spindles are fitted with similar face-milling cutters, of about 4 in. diameter, with 10 carbide-tipped inserted blades. These cutters are arranged to machine a flat face on top of the casting near each end, also the two vertical end faces.

At the end of the traverse of the slide, the casting is carried into engagement with the milling cutter for the location slot, which penetrates to a depth of about 0·35 in. After the slide has returned to its original position the clamps are released, and at subsequent movements of the transfer bar, the casting is carried to an idle position, and then into the turn-over unit beyond. This unit, of the drum type, has a hydraulically-operated rack at the top, the teeth of which are engaged with gear teeth on the drum. The portion of the transfer track within the drum is displaced from the centre, and when the drum is turned through 90 deg., the casting is carried downwards and held with the half-bore to the left, resting on one of the side faces.

In this position, the casting is held directly beneath the second transfer bar, which is similar

in design to the first, in line with a narrower track having guide faces at each side. This transfer bar is operated by a long-stroke hydraulic cylinder, carried on a bridge member above the third machining station, and the casting passes through three idle positions after leaving the turn-over unit.

DUPLICATED DRILLING AND REAMING STATION

The next operations performed, at station 2 in Fig. 2, are the drilling and reaming of the holding-down bolt holes from the solid, and are carried out on two castings simultaneously, at two successive stages. Because of the shortness of the cycle at the majority of the machining stations, and the length of time required to penetrate 2·5 in. of cast iron without using feed rates so high as to cause excessively rapid tool wear, the drilling and reaming heads (also the heads at the third machining station), are duplicated and are arranged to operate during two full cycles, so that the time for these stages is 89 sec. To provide for this double cycle, the second transfer bar operates only at alternate cycles of the remainder of the machine, and it moves through twice the stroke length of the other bars so that two castings are advanced at a time.

Close spacing of the bolt holes makes it necessary to drill alternate pairs of holes from opposite sides of the track, and the unit heads employed, which are from the standard Ordzonikidze range, are fitted with extra long spindle adapters designed to cover four casting positions. A view showing this second—multiple—machining station from the right-hand side of the track is given in Fig. 4, which also shows the transfer cylinder in the background and the clamping arrangements. When the transfer bar is operated, two castings are moved from the idle positions at the left (here unoccupied), to positions directly opposite the two cylinders *F*, whereby the clamps are applied.

Location of the castings at these positions is obtained by means of plungers which are raised into engagement with the locating slots in the now downward-facing edges of the joint surfaces, by hydraulic cylinders in the bed unit. The clamps are then applied by the cylinders *F*, through vertical levers, pivoted at their lower ends. Cross beams on these levers carry plungers which pass through holes in the bush plate and apply pressure directly to the curved rear faces of the castings, to hold them in contact with support faces on the opposite side of the track.

The multi-spindle head on the far (left-hand) side of the track has two sets of nine spindles, which operate on the castings clamped by the cylinders *F*. Six spindles of each set are employed for drilling holding-down bolt holes, and three for drilling smaller, blind holes, one in the half bore and two in the joint faces of the larger end cap. Two sets of spindles in the head in the foreground are employed to drill the four remaining bolt holes, and two blind holes in the flat (outer) face of the larger end cap, in each of the two castings.

When the castings are transferred to the reaming positions at this station, they are again located by the slots and are clamped hydraulically by a mechanism which is similar to that provided at the drilling positions, except that both clamps are applied by a single cylinder *G*, through a lever of cruciform shape.

At the far side of the track, the head has two sets of six spindles with reamers for operations on the bolt holes drilled at the two previous posi-

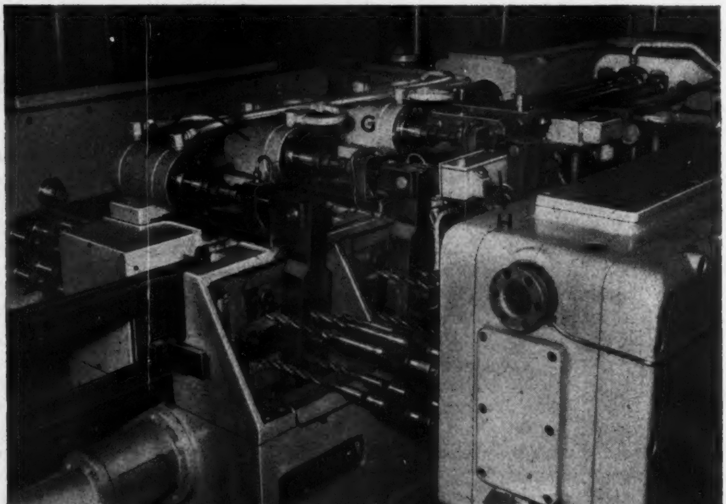


Fig. 4. After passing through the turn-over unit, in which it is turned on to its side, the cluster casting reaches this station where drilling and reaming operations are duplicated

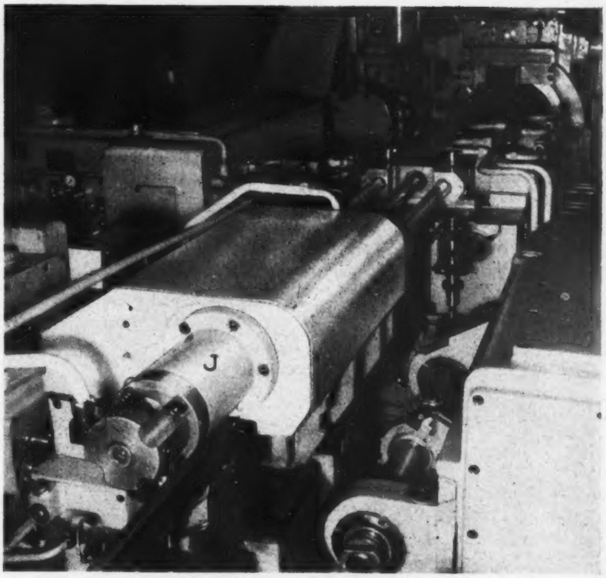


Fig. 5. The turn-over unit is seen in this view looking back along the transfer machine from station 3 in the foreground. The second transfer bar is moved by the hydraulic cylinder *J*

tions. Spindles in the head in the foreground are employed to ream the four holes in each casting drilled previously from this side. This head also carries two sets of probes which enter the two small holes in the top face of the larger end cap of each casting to ensure that they have been drilled to a sufficient depth for safe tapping at a later stage.

It may be noted that provision is made for automatic lubrication of all moving parts of the machine by means of several hydraulically-operated pump units, which deliver oil from a reservoir along pipelines leading to various points. The units are standardized, and one example is indicated at *H*, in Fig. 4.

GROOVE-MILLING AND TAPPING OPERATIONS

Two idle positions follow those at which reaming is carried out before two castings are moved into the clamping positions of the third machining station, seen in the foreground in Fig. 5, where the operating cylinder for the second transfer bar is indicated at *J*. Location of the castings at this and subsequent stations is obtained by means of plungers which engage reamed bolt holes, the plungers being advanced by a hydraulically-operated mechanism at one end of the bed casting. Clamping force is applied by horizontal, rectangular plungers, which are moved into contact hydraulically with the curved rear faces of the castings, to press the joint

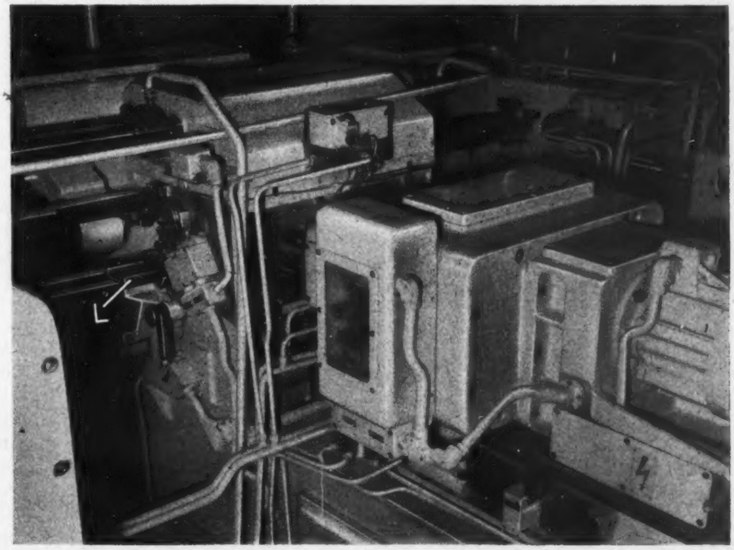


Fig. 6. Another view of station 3, from the right-hand side of the track, showing the head, with four spindles, for tapping two holes in each of two castings, and the retractable portion *L* of the transfer track

faces against projecting shoulders on the opposite side of the track.

The head at the left of the track, as viewed in the direction of transfer (seen at the right in Fig. 5), is equipped with a milling adapter incorporating a spindle with two pairs of narrow milling cutters. These cutters are fed forward to plunge-cut the oil seal grooves in the leading—larger—end cap of each block casting, to widths of approximately 0·25 and 0·19 in., and depths of 0·75 and 0·25 in., respectively. A view of this station from the right-hand side of the track is given in Fig. 6, and shows the tapping head which has two pairs of spindles for operation on the two small holes drilled in each casting at the previous station. With this head, the tapping cycle is controlled by a stop disc, driven from the spindle.

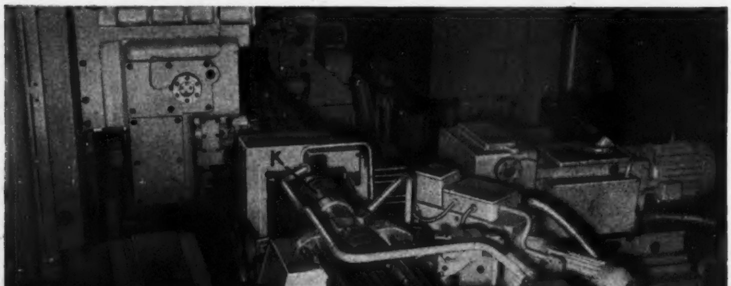


Fig. 7. With station 4 in the foreground, this view also shows station 5, for chamfering all 10 bolt holes at the joint face, and station 6, at which there is a vertically-traversing milling head

As the milling head on the opposite side of the track is fed towards the castings, the bearing housings for the spindle move into a position in which they overlap the transfer track at each side of the clamping unit. Provision is therefore made at this station, and others at which milling operations are performed, for the interfering portions of the track to be automatically retracted during the machining cycle. One such retractable portion of track is seen at L in Fig. 6, and it is secured to a bracket on a horizontal shaft which passes through the bed unit and carries a similar bracket at the other end. At the start of the machining cycle, the shaft is turned by a hydraulic cylinder, and it is restored to its original position after the milling head has been retracted, to restore continuity of the track for the next transfer movement.

MILLING AND SPOT-FACING OPERATIONS

On leaving the third station the castings pass through two more idle positions before they are moved, one at a time, to the fourth station, which provides for milling the bearing retainer slots in one side of the half bore and spot-facing five of the holding-down bolt holes. The station is shown in the foreground in Fig. 7, and the castings are moved by the third transfer bar, which is actuated by the cylinder K, at the fifth station. Location and clamping arrangements are similar to those at the previous station, except that the clamping cylinder is mounted above instead of beneath the work holding unit.

The adapter on the head at the left-hand side is equipped with a spindle with five milling cutters of about 2·5 in. diameter by 0·25 in. thick, which are advanced to cut the bearing retaining slots in the upper edge of the half bore. Before the head is fed forward, the transfer tracks at each side of the holding unit are lowered, as before, and they are raised again after the milling operation has been completed. The head at the right is provided with a 5-spindle adapter, with spot-facing cutters which operate on two of the upper and three of the lower bolt hole bosses.

Two further idle positions follow, before the casting is indexed to the fifth machining station, where it is again located from the bolt hole and clamped by the action of a cylinder at one side. The left-hand head at this station has ten closely-spaced spindles which are employed to chamfer the joint-

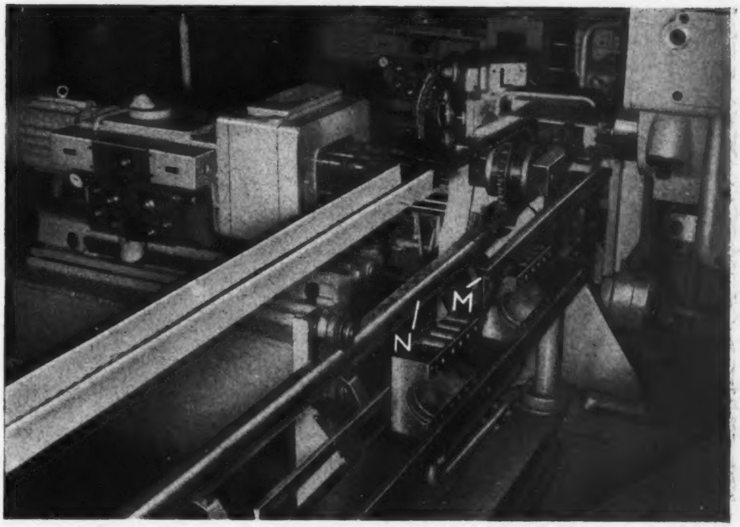


Fig. 8. This view, looking back towards station 6, shows the vertically-traversing milling head and the spot-facing and angular heads. The third and fourth transfer bars are seen at *M* and *N*

face ends of the bolt holes. There is no head at the right-hand side at this station.

After passing through two more idle positions, the casting is moved into the sixth machining station, where it is located and clamped as before. A column at the left-hand side at this station carries a vertically-moving milling head with a horizontal spindle carrying a 3-in. diameter face-milling cutter. The support surfaces to which the casting is clamped at this station are cut away at a position adjacent to the larger end cap to provide clearance for the cutter, which machines a shallow recess in the face for a distance of about 1·25 in. from the end of the casting.

At the right-hand side of station six there are two heads, one of which has five spindles and is employed to spot-face the remaining bolt hole bosses. This head is seen at the left in Fig. 8, which is a view looking back along the line. The other head at this station, seen at *L*, is arranged at an angle to the line. A single spindle in this head is fitted with a drill of about 0·45 in. diameter, which produces a hole in the rear face of the casting. This hole is drilled to such a depth that it breaks into the hole drilled in the half-bore at station 2, and into the larger of the two oil seal grooves in the larger end cap. Examples of castings in the condition in which they leave station 6 are shown in Fig. 9.

CUTTING OFF OPERATIONS

The two remaining stations provide for parting the block casting into five separate bearing caps, as seen at the left in Fig. 1, and are served by the fourth transfer bar. This bar is arranged to move the castings through a longer stroke length than the previous bar, because the stations are more widely spaced to suit the extra width of the milling units employed. In Fig. 8, the end of the third transfer bar is seen at *M*, the castings in the foreground being in approximately the positions to which they are moved by this bar after the completion of the operations performed

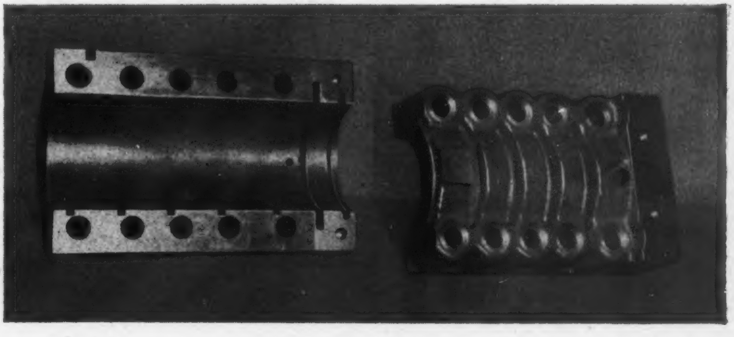


Fig. 9. Examples of partly-machined castings, showing the stage to which they are brought by the operations performed at the first six stations

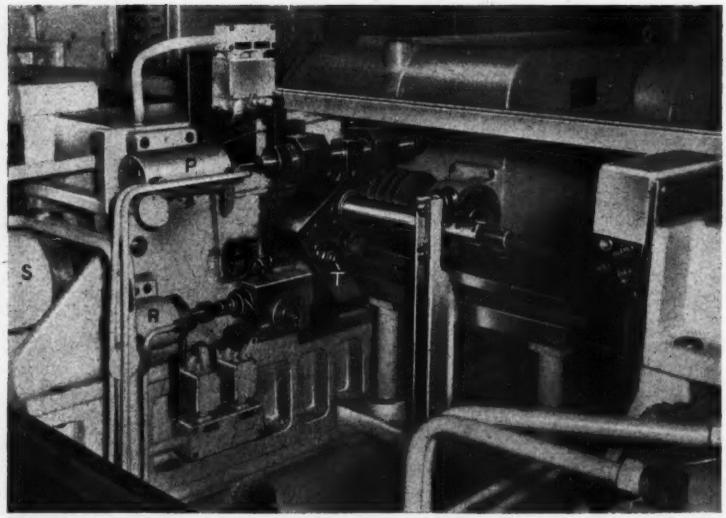


Fig. 10. This view, looking back at the seventh station, shows the cylinder *P* for turning the fourth transfer bar to bring the fixed projections into engagement with the castings, and the massive milling head on the far side of the track

at station 6. The fourth transfer bar is seen at *N*, and it is of cylindrical form with fixed projections whereby the castings are pushed along the track.

This bar is carried in grooved rollers on brackets extending upwards from bars which connect the bed units, and is coupled at each end to a length of roller chain which is supported in a steel channel. The chain passes over sprockets mounted on brackets at station 6 and at the unloading end, the latter sprocket being carried on a spindle which can be turned by means of a hydraulically-operated rack and pinion arrangement. When the ram of the vertical hydraulic cylinder is operated, the bar is moved longitudinally to transfer the castings. Rotary movement of the bar, to move the transfer projections into or out of engagement with the castings, is imparted by a hydraulic cylinder on the side of the clamping unit at station 7.

This cylinder is seen at *P* in Fig. 10, which is a close-up view of station 7, looking back along the track, and the ram is connected to a horizontal plunger carried in bearings on the side of the unit. The transfer bar passes through a bracket in which there is a captive bush, keyed to the bar. This bush is linked to the plunger so that when the cylinder is actuated, the bar is turned. Another cylinder *R*, on the side of the head, is connected to a rack and pinion system whereby a shaft is turned to advance the locating plungers into the bolt holes.

For clamping the casting, a large-diameter cylinder S applies thrust directly to the rear, to hold the joint surface in contact with slotted faces on the other side of the track. On the far side

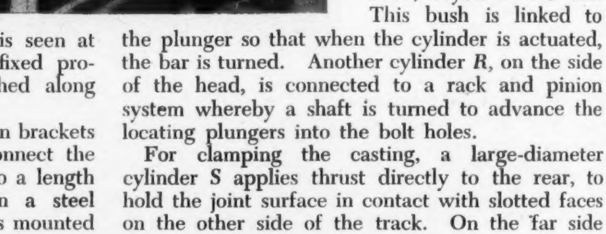
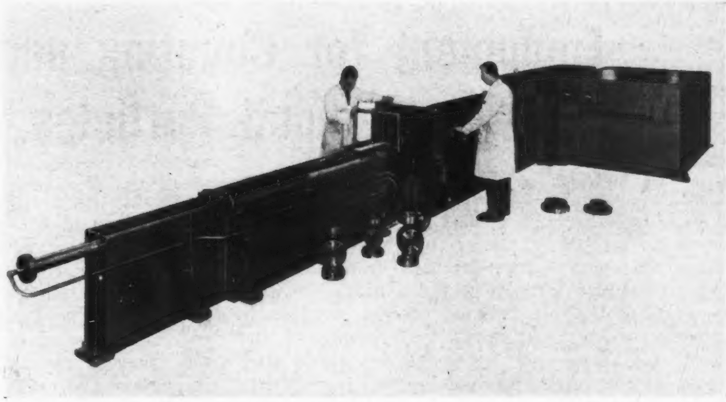


Fig. 11. The actuating mechanism for the fourth transfer bar comprises a length of roller chain and two sprockets, one of which is turned through rack and pinion by the vertical hydraulic cylinder at the left

of the unit, in a position similar to that occupied by the cylinder *R*, there is another cylinder, the ram of which is connected by a link to a shaft passing horizontally through the housing. The end of this shaft is seen at *T*, and it carries levers which are welded to movable portions of the transfer track at each side of the clamping position. Before the milling unit is fed forward partially to sever the caps, these portions of the track are moved downwards to clear the milling spindle housings, and they are subsequently restored to position for the next transfer movement.



Built to the specification of Cameron Ironworks, Ltd., this Lapointe horizontal hydraulic broaching machine is considerably lower than normal, to facilitate broach handling

A more general view showing the transfer mechanism, and the vertical hydraulic operating cylinder at the left, is given in Fig. 11, looking back along the line, and the two milling units are seen on the right. The spindle of each head is fitted with four slotting cutters of about 6 in. diameter by 0·25 in. thick, with 60 teeth. These cutters are driven at approximately 30 r.p.m., and the heads are advanced rapidly to bring them to the working positions. The total thickness of the castings is about 2·5 in., and the cut is shared approximately equally between the two gangs of cutters. Finally, the castings are discharged from the machine along a curved chute.

A large rotary selector switch and push-buttons on a panel near the loading station provide for control and adjustment, as on the machine described in the previous article. There is also a tool control board with counters which are operated from the various stations so that the numbers of cutting cycles are automatically recorded, and a spare set of tools in pre-set holders is accommodated alongside each counter dial.

Special Lapointe Horizontal Hydraulic Broaching Machine

The accompanying illustration shows a horizontal hydraulic broaching machine which has been built by Lapointe Machine Tool Co., Ltd., Otterspool, Watford By-Pass, Watford, Herts., to the specification of Cameron Ironworks, Ltd., Queen Street, Leeds, 10. It is intended primarily for broaching rectangular cavities in forged steel bodies for gate valves, for oilfield equipment, which range in nominal size from 2 to 6 in. and will withstand pressures up to 15,000 lb. per sq. in. Provision is made for accommodating either individual bodies, examples of which are seen in the figure, or blocks for multiple units, and as an indication of capacity, it is stated that when the full stroke of 100 in. is employed, a starting hole of $2\frac{5}{16}$ in. diameter can be enlarged to an aperture with cross-sectional dimensions of 5½ by 2⅜ in., with a total of 14 passes.

To facilitate handling the large number of broaches which is required during the progress of an operation, the height is considerably less than that of a normal Lapointe machine. For this reason, it proved impossible to mount the tanks for hydraulic fluid in the base, and they are housed, together with other hydraulic equipment and the associated motors, in a power unit which is attached to one end. Broaching speeds from 1 to 21 ft. per min. can be obtained, in three ranges, and are selected by push-button. Provision is made for guiding the trailing end of the broach throughout the stroke. Coolant equipment is incorporated, and the reservoir is housed in a pit in the shop floor, directly below the working area.

This machine, which is approximately 38 ft. long and weighs 13¾ tons, is to be installed in the works of the French company of Cameron Ironworks, Ltd., and has been despatched by way of the recently-introduced door-to-door Channel ferry service.

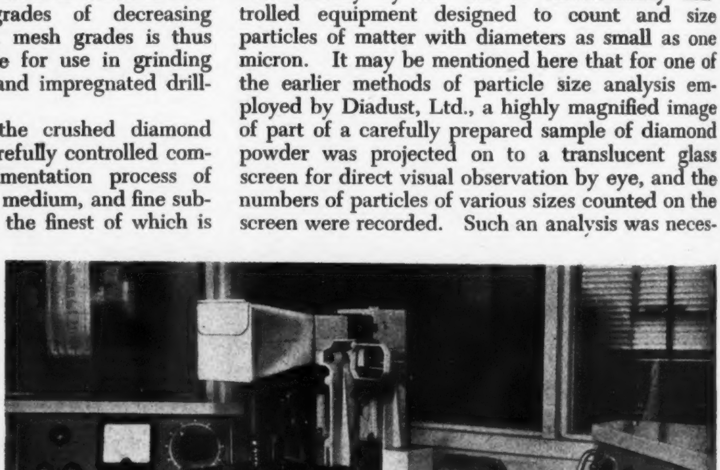
Equipment for Counting and Sizing Diamond Particles

Diadust, Ltd., one of the companies in the L. M. Van Moppes & Sons, Ltd., Group, are concerned with the processing, testing, weighing, and packing of diamond powder, produced from boart, for use in industry throughout the world. The preparation of Diadust diamond powder is a 4-stage process which starts with the crushing of the boart into fragments not exceeding about 0·01 carat weight. Material thus obtained is treated in order to remove impurities present in the natural boart and foreign matter picked up during crushing. At the third stage, the larger particles are separated from the mass by sieving into coarse, medium, and fine divisions, each of which is then sub-divided into seven grades of decreasing coarseness. A total of 21 mesh grades is thus obtained, which are suitable for use in grinding wheels, stone cutting saws and impregnated drilling bits.

Finally, the residue of the crushed diamond powder is separated by a carefully controlled combined elutriation and sedimentation process of long duration into 13 coarse, medium, and fine sub-sieve or micron size grades, the finest of which is composed of particles measuring less than 0·5 micron (0·0005 mm.) in diameter. The sub-sieve grades of powder are widely employed in lapping and polishing processes, as required, for example, in the production of tungsten carbide dies, gauges of hardened steel, optical glass parts, and synthetic jewel bearings.

In the elutriation and sedimentation process, the buoyant force of a moving stream of water is employed for the separation and distribution of the finely-divided diamond particles in a number of cone-shaped glass vessels, connected in series, so that the coarsest particles remain in the first vessel and the balance of the powder is carried over and deposited successively in the other vessels in decreasing order of particle size. The contents of the sedimentation vessels are removed and dried prior to particle size determination which is regarded as being of great importance, since it is the means of controlling uniformity in each grade throughout the range.

The size analysis of sub-sieve particles of diamond powder by traditional methods which rely on bench type and projection microscopes is lengthy and tedious, and it may now be performed automatically by the use of electronically controlled equipment designed to count and size particles of matter with diameters as small as one micron. It may be mentioned here that for one of the earlier methods of particle size analysis employed by Diadust, Ltd., a highly magnified image of part of a carefully prepared sample of diamond powder was projected on to a translucent glass screen for direct visual observation by eye, and the numbers of particles of various sizes counted on the screen were recorded. Such an analysis was neces-



Casella automatic particle counting and sizing equipment installed at the works of Diadust, Ltd.

sarily conducted slowly in order to reduce errors of observation and recording, and usually required the participation of two persons. With the modern equipment now employed by the company for this work, however, an analysis can be obtained in less time and to a higher standard of accuracy by one operator, under improved conditions and without undue fatigue. The equipment, which is shown in the accompanying illustration, is known as an automatic particle size analyser, and is a product of Casella (Electronics), Ltd., Haxby Road, York. Briefly, the required result is obtained by scanning to and fro along a narrow sinusoidal track which traverses an area covered by a dispersal of diamond powder. The magnified image of each successive particle encountered is transmitted through a calibrated slit on to a photo-multiplier which is adjusted to give standard maximum and minimum signals corresponding to nil and total obscuration of the slit.

Particle images are projected by a microscope, with a magnification of 220 ×, illuminated by a Kohler light system which is so arranged as to avoid variations in lamp output. The width of the slit opening in front of the photo-multiplier may be varied by a micrometer adjustment from 0 to 10 mm., and is set to a specific value when the magnification of the optical system is altered. Filters, held in a turret, are employed in conjunction with the gain and dark level controls to measure the optical density of the particles and thus eliminate the effects of opacity.

Output of the photo-multiplier is fed into a pulse height discriminator which may be regarded as an electronic gate and can be adjusted to pass a pulse to the counting circuit only when a certain proportion of the slit is obscured by a particle. The discriminator adjustment is made by means of a potentiometer which has settings marked from 0 to 1, and any figure may be chosen to represent the minimum particle size which will be recorded during a scanning run.

The stage on which the specimen of diamond powder is mounted is supported on vertical leaf springs and reciprocated from side to side by a cam and lever mechanism, and the forward and rearward travel of the stage is derived from a gear train. Drive to both motions is provided by an f.h.p. motor. During the counting operation, scanning of the specimen takes place over 10-mm. long paths, separated by a distance of 50 microns. The drive shaft is provided with two discs, one of which produces a pulse at every revolution and transmits it to a decatron counting tube system. On the completion of 100 oscillations, during a 5-mm. travel, a pulse from the decatron reverses the motor and the stage is returned to its starting point. During the return movement, scanning continues, but the path is staggered in relation to that followed during the forward movement, and the total length scanned is 2,000 mm. The second disc is slotted to act as a shutter for a light cell which operates a gate to prevent counting, and the disc is so positioned as to cut off the light from the photo-cell when the stage approaches its reversal points. At these points, the scanning track is U-shaped and recording is not desired because of speed variations. Thus, counting takes place only for the straight portions of the scanning track.

Satisfactory results of counting and sizing analyses depend on the preparation of suitable slides for mounting on the scanning stage, and Diadust, Ltd., have developed a technique which ensures even distribution of diamond particles over the scanning area. A trained laboratory worker applies a mixture of a known quantity of diamond powder dispersed in a mixture of Canada balsam and xylene to a standard microscope slide and cover glass. Pressure is applied to the cover glass to expel most of the mixture and the remainder is allowed to harden. A very thin film is thus obtained with the diamond particles to be counted and sized in one plane.

When a count is taken of particles in a sample of diamond powder the equipment is set to reject information relating to all particles smaller than the minimum size to be recorded. Three scanning runs are made, the slit width w and the discriminator setting p being varied for each run. The counts obtained during the three scanning runs are recorded and substituted for symbols in a simple equation which, when resolved, gives the number of particles contained in an area of 1 sq. mm. It should be noted that a number count cannot be obtained from a single scan with a given slit width.

To obtain a size distribution of particles a further series of scans is made with different values of p w arranged in a $\sqrt{2}$ progression and the numbers obtained for each setting are recorded on a programme sheet. A linearity check may be made by plotting the results graphically from which any errors due to faulty settings of the controls may be observed.

EXPORTS OF MACHINERY, other than electric, during the first quarter of this year reached a total value of £213,003,868, as compared with £183,866,664 during the same period of 1960. Principal markets for the first quarter of 1961 were, Australia (£15,865,342), U.S.A. (£12,952,465), Canada (£12,170,296) and India (£11,490,363).

Churchill Grinders at the British Trade Fair, Moscow

EXHIBITS OF THE CHURCHILL MACHINE TOOL CO., LTD., Broadheath, Manchester, at the British Trade Fair, held recently in Moscow, included their latest type BW cylindrical grinder, which was fitted with an electro-pneumatic sizing unit, and automatic work loading and unloading equipment of new design, as shown in Fig. 1.

The type BW machine, which was described in MACHINERY, 96/1487—22/6/60, has a maximum swing capacity of 10 in. diameter, and work up to 20, 36 or 60 in. can be held between the centres, depending upon the length of the bed. Designed for operation on a fully automatic cycle for plunge grinding operations only, the machine has a patented diminishing feed system, and there is provision for automatic wheel dressing and compensation after a pre-set number of parts has been ground. Since in-feed—and consequently grinding pressure—is progressively reduced during the working cycle, the work is held to a high degree of accuracy for roundness as well as diameter.

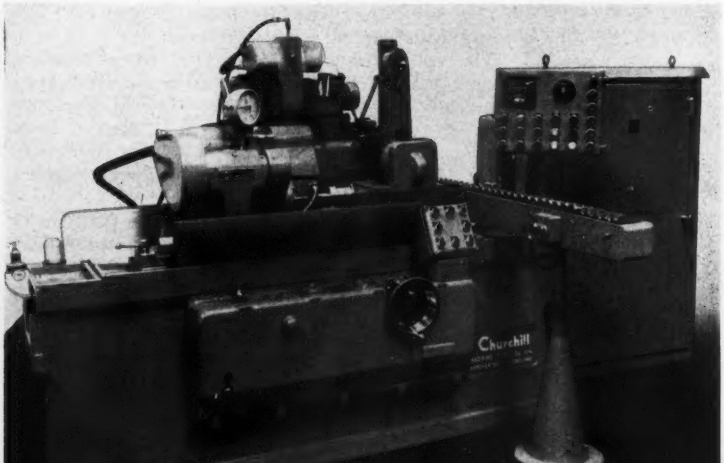


Fig. 1. A Churchill type BW cylindrical grinder, fitted with an electro-pneumatic sizing unit and work loading and unloading equipment of new design, as here shown, was exhibited at the recent British Trade Fair, Moscow

A micro-switch, operated by the loading equipment, initiates the grinding cycle, and the work-head is then started, the coolant is turned on, and the gauging head for the sizing equipment, which is mounted on the table as shown at *A* in the close-up view Fig. 2, is advanced to bring the caliper of the measuring equipment into engagement with the work.

The machine wheel-head is then advanced towards the work under rapid power traverse. At the end of this travel, grinding commences at a coarse feed rate, which is progressively reduced to a fine rate for finish grinding. When the work has been brought to a predetermined diameter, close to the required size, an electric signal transmitted by the gauging equipment operates a solenoid-operated stop valve in the exhaust line of the hydraulic feed system, to stop the inward traverse of the wheel-head.

The latter unit dwells for sparking out, and when the required work diameter is reached, a second signal is transmitted by the sizing equipment, with the result that the gauging unit and the wheel-head are returned to the starting positions. Finally, the coolant supply is turned off and the work-head is stopped to complete the grinding cycle.

Next, a hydraulically-operated loading arm mounted on the tail-stock, is swung to the left into the horizontal position, as shown at *B*. During this movement, a pair of jaws at the outer end of the arm is swivelled independently, through 90 deg., and then closed hydraulically to grip the ground component. The entire assembly and the tail-stock barrel is now moved horizontally to the right to bring the component clear of the

work driver on the headstock spindle. When the loading arm has been traversed to the full extent, movement of the tailstock barrel continues independently, to bring the centre clear of the end of the work. The loading arm is now swung to the right through 180 deg., the gripper jaw assembly being simultaneously swivelled independently, so that the component is maintained in the horizontal position. Next, the gripper jaws are opened to discharge the ground component on to one of a number of cradles attached to an indexing, chain-type, conveyor, which is mounted at the end of the bed at right-angles to the machine centre line, as may be seen in Fig. 1.

The conveyor is now indexed to bring a fresh component into line with the gripper jaws, the ground piece being simultaneously moved in a direction towards the rear of the bed. When the jaws have been closed to grip the fresh workpiece, the loading arm is swung through 180 deg. in the opposite direction to bring the part into line with the work-head and tailstock centres. Next, the tailstock barrel is moved to the left, independently for the first part of its travel, to bring the centre into contact with the work, and then with the loading arm assembly, to press the work into engagement with the driver. Finally, the gripper jaws are opened and the loading arm is swung to the right through 90 deg. and then locked, so that it is held in the vertical position while grinding is in progress. The grinding cycle is then started.

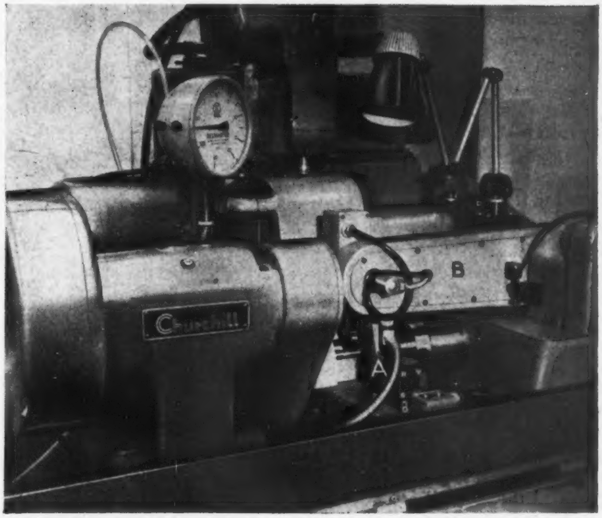


Fig. 2. In this close-up view of the Churchill type BW cylindrical grinder, the gauging head of the sizing equipment is shown at *A*, and the hydraulically-operated loading arm at *B*

The work conveyor and loading arm here described has been designed primarily for use on Churchill grinders which are installed with other machines in a link line. Alternatively, these units may be employed in conjunction with articulated and gravity-type magazines for handling workpieces on machines which are arranged in a group. Since the conveyor is located at the tailstock end of the bed, the operating position is left clear and there is free access for setting up and maintenance work.

If required, the Churchill type BW machine can also be fitted with an indexing work conveyor of the type which was described in MACHINERY, 98/83—11/1/61. With this arrangement, the entire conveyor unit, which is mounted at the front of the bed, is pivoted towards the work axis at the end of the grinding cycle. As a result, a pair of spring clips attached to the conveyor is passed over the ground workpiece. When the part has been released from the work-head and tailstock centres, it is moved clear, and a fresh part is brought to the grinding position, by the indexing motion of the conveyor. When the fresh component is held by the centres, the conveyor is swivelled to its original position, and grinding can then proceed.

TYPE HBM AUTOMATIC INTERNAL AND FACE GRINDING MACHINE

The latest type HBM automatic internal grinder, which was exhibited, incorporates a recently-introduced face grinding head and a new work loading unit, as shown in Fig. 3. Arranged for operation on a single automatic cycle, or a double cycle with intermediate truing, the machine will swing a maximum diameter of 12 in. inside the work guard and 19 in. over the table, and enables bores up to 8 in. diameter to be ground for depths up to 5½ in. It can be set for plunge cutting when short bores are to be ground. If required, the solenoid-operated mechanism which provides for automatic working can be disengaged when parts are to be handled singly. Plug gauge sizing equipment can be provided, and there is a "feed accelerator" arrangement whereby a rapid approach is maintained until the wheel starts to

cut. Consequently, the cycle time is reduced if the grinding allowance on the work is less than that for which the feed mechanism has been set. Details of the basic type HBM internal grinder were given in MACHINERY, 88/1132—22/6/56.

The face grinding head can be brought into operation as part of the automatic working cycle, and may be adjusted vertically for positioning the wheel in relation to the work. In addition to operations on the end faces of workpieces, the head may be employed for grinding the ends of blind bores.

When a component has been loaded into the chuck on the work-head, an upper slide, which carries the face grinding spindle, is advanced transversely to bring the wheel to a position above the work axis. The work-head is now started, and the face grinding head is advanced towards the work under rapid power traverse. When the wheel has been brought close to the end face of the work, the rapid power traverse motion is stopped and feed, which is progressively diminished as grinding proceeds, is applied to the head. At the end of the face grinding operation, the head is returned to its starting position, and the wheel is then automatically dressed. During the dressing operation, a relief is formed on the wheel to provide a cutting edge at the periphery. Next, the head is automatically adjusted to compensate for the reduction in the width of the wheel which has resulted from dressing. A switch is now operated to energize a solenoid which causes the table to be rapidly traversed in preparation for the internal grinding part of the cycle.

Workpieces to be ground are passed to the loading unit on the machine by way of a chute or a magazine, at the lower end of which there is a gate. Incorporated in the loading unit is a carriage, which is provided with a swing arm, and can slide in the horizontal direction on guide bars supported at their ends by brackets fixed to the bed. At the beginning of the loading cycle, the carriage is traversed in a direction towards the work-head, so that an arbor at the outer end of the swing arm is passed into the bore of the workpiece held in the gate. The carriage is now moved in the opposite direction, and the arm is then swung downwards. Next, the carriage is again moved in a direction towards the work-head to bring the component into contact with end stops in the chuck. When the chuck jaws have been closed, the swing arm and the carriage, which are operated by compressed air, are returned to their original positions, and the grinding cycle is started. After the chuck has been opened at the end of the grinding cycle, the component is ejected by a built-in spring-loaded plunger, and is discharged from the machine by way of a chute.

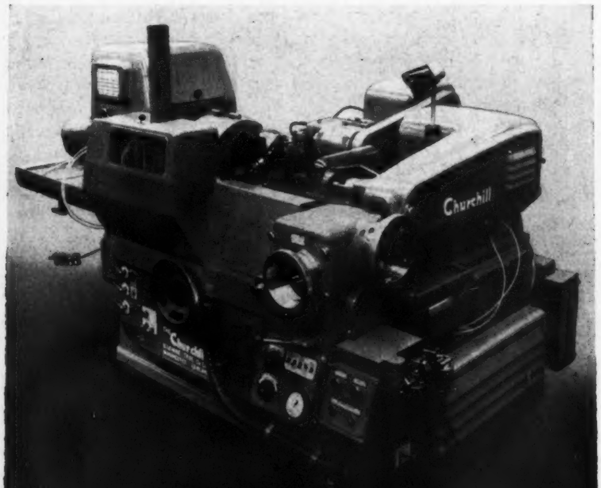


Fig. 3. Churchill type HBM internal grinder fitted with a recently-developed automatic face grinding head, and a new work loading unit

TYPE EC CENTRELESS GRINDER

In Fig. 4 is shown the Churchill type EC centreless grinder, fitted with an automatic work loading unit and automatic size control equipment, as demonstrated at the Fair, for grinding needle rollers. With this set-up, to which reference was made in MACHINERY, 95/464—9/9/59, it is stated that $\frac{3}{16}$-in. diameter by 1-in. diameter rollers can be ground to a tolerance of 0·0002 in., and a surface finish of 2 micro-inches, at the rate of 12,000 to 15,000 per hour, and two or three machines may be tended by one operator.

Rollers to be ground are passed through an opening in the cover of the loading unit at the front of the bed, to be discharged on to a disc which is driven by belts and gears from a motor. The rollers are then moved outwards by centrifugal action into contact with the rim of a sur-

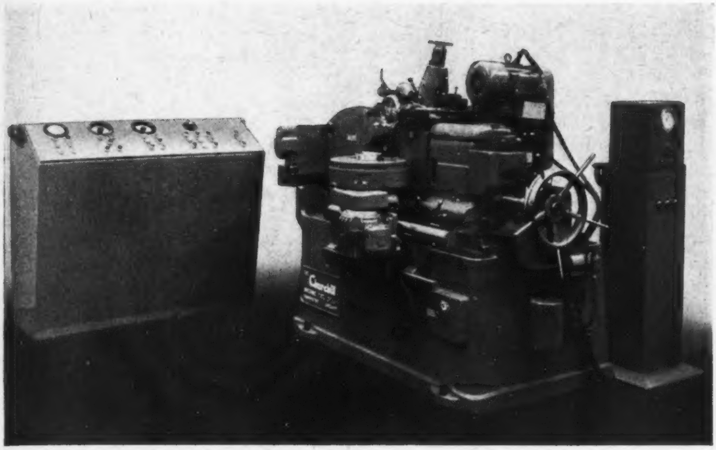


Fig. 4. The Churchill type EC centreless grinding machine is here shown equipped with a rotary-type work loading unit and compressed air automatic size control equipment, and is set up for grinding needle rollers

rounding drum, and are passed, singly, through a nozzle on to the work plate, to be fed between the grinding and control wheels.

As each component leaves the grinding throat, it passes through a gauging unit, and the diameter is sensed by compressed air, which is delivered through nozzles at intervals, under the control of a timer. The diameter of the work in relation to the nominal size is shown by an indicator unit at the rear of the machine, and as the grinding wheel wears, the increase in diameter causes a signal to be transmitted to a feed compensating motor by way of the control unit. The output shaft of this motor is then turned through one revolution, and motion is transmitted to the feed screw by crank disc and link, ratchet mechanism, and worm gearing. The amount of feed thus applied can be varied by adjusting the throw of the link on the crank disc. In this way, correction is applied to the control-wheel slide before the work diameter exceeds the upper limit. If the work diameter should fall below the lower limit, a visual or aural signal is energized, and the feeding of workpieces is stopped.

The feed screw engages with a nut of the ball-circulating type, so that the risk of stick-slip is avoided when very small adjustments are being made, and the control-wheel slide is mounted on roller guideways which ensure sensitive movements.

Personal

Mr. R. F. Hockin, A.C.W.A., A.M.I.Mech.E., has resigned from the board of Burtonwood Engineering Co., Ltd., in order to devote more time to his other interests.

Mr. Norman Readman, managing director of the Consolidated Pneumatic Tool Co., Ltd., of 232 Dawes Road, London, S.W.6, has been elected president of the Chicago Pneumatic Tool Company, New York, U.S.A.

Mr. H. C. Fox, M.I.E.E., has retired from George Ellison, Ltd., Perry Barr, Birmingham, 22B, after 47 years' service. In 1926 he was made responsible for the design and development of high voltage switchgear, and from 1937 onwards he planned and laid out the Ellison ASTA authorized testing station.

The following new appointments have been announced:—

Mr. F. T. Davies, A.C.I.S., A.M.I.W.M., as financial director and secretary of Dialoy, Ltd., Colchester Factory Estate, Cardiff.

Sir Edward Playfair, K.C.B., as chairman of International Computers and Tabulators, Ltd., Gloucester House, 149 Park Lane, London, W.1, with effect from August 1 next, when he will be released from the post of Permanent Secretary to the Ministry of Defence.

Mr. D. Major, B.A., B.Sc., as assistant chief engineer of the X-Ray Department of the Instrumentation Division, Associated Electrical Industries, Ltd., Crown House, Aldwych, London, W.C.2.

Mr. A. H. H. Young, B.Sc. (Eng.), A.M.I.E.E., as general manager of the Derby Works of Crompton Parkinson, Ltd., Crompton House, London, W.C.2. He will be responsible to Mr. R. F. D. Milner.

Mr. A. H. Campbell, M.A., M.I.E.E., a director of the company since 1951, and general manager since 1954, as joint managing director, with Mr. G. A. Whipple, M.A., M.I.E.E., F.Inst.P., of Hilger & Watts, Ltd., 98 St. Pancras Way, Camden Road, London, N.W.1.

Mr. G. A. Jones, formerly South Wales regional manager for Grant, Lyon & Co., Ltd., Scunthorpe, Lincolnshire, a member firm of the Chamberlain Group, as technical representative for the company for the whole of England and Wales with the exception of Durham and Northumberland.

Gefra Twist Drill Milling Machine

FUNDITOR, LTD., 3 WOODBRIDGE STREET, LONDON, E.C.1, have recently been appointed sole agents in this country for the range of twist drill milling machines built by N.V. Maschinefabriek Gefra, The Hague, Holland.

Shown in Fig. 1, the Gefra type VM-1 machine, which was demonstrated recently at the Funditor works at Wembley, Middlesex, is designed to mill two flutes and clearances at the periphery, on twist drills from $\frac{5}{32}$ to $\frac{29}{64}$ in. diameter, on a fully-automatic continuous cycle. The maximum milling length obtainable is $4\frac{17}{32}$ in. Driven by belts from separate electric motors, the cutter heads are grouped at the nose end of the hollow work spindle as shown in the close-up view Fig. 2, and since milling is carried out simultaneously on both flutes and clearances on the blank, a balanced cutting action is obtained. The cutter heads for milling the peripheral clearance are mounted on a swivel carrier, and the entire assembly can be turned on a horizontal axis for varying the amount of land produced on the drill. The other heads can be swivelled in the horizontal plane, and are normally set to the helix angle of the flutes, to be milled in the blank. If required, the setting can be varied, by a maximum of about 3 deg., for milling flutes which are slightly wider than the cutters. Climb milling is employed, and the special cutters are form-relieved.

A collet is incorporated in the work spindle for holding the blank while milling is in progress, and between the spindle housing and the swivel carrier for the cutter heads for milling the peripheral clearances, there is a split bush, which can be adjusted by threaded cone-shaped end pieces, so that the bore makes contact with the blank to provide support. Over the central portion, the bore is enlarged, and there are radial slots in the bush through which the milling cutters pass.

When milling is in progress, the work spindle is simultaneously turned and traversed in an axial direction, so that the blank is moved past the cutters, by the action of a hollow cylindrical lead bar at the rear end, which is driven from a barrel pinion, through a large-diameter gear, as may be seen in the close-up view Fig. 3. A total of seven interchangeable lead bars is provided with the machine for milling flutes with helix angles from 15 to 35 deg. If the helix angle of the flutes to be milled in the blank differs by a small amount from that of the spiral groove in the lead bar, a second groove may be machined in the bar.

Drive to the barrel pinion for imparting feed to the drill blank, is taken from a motor housed in the base, through a belt and expanding pulleys, and thence through a speed reduction unit. With this arrangement, the feed may be varied steplessly to suit the diameter of the blank to be milled. The cutter spindles of the flute-milling heads are mounted in eccentric bearing housings, which are turned while milling is in progress, by a pair of arms, so that a web of progressively increasing

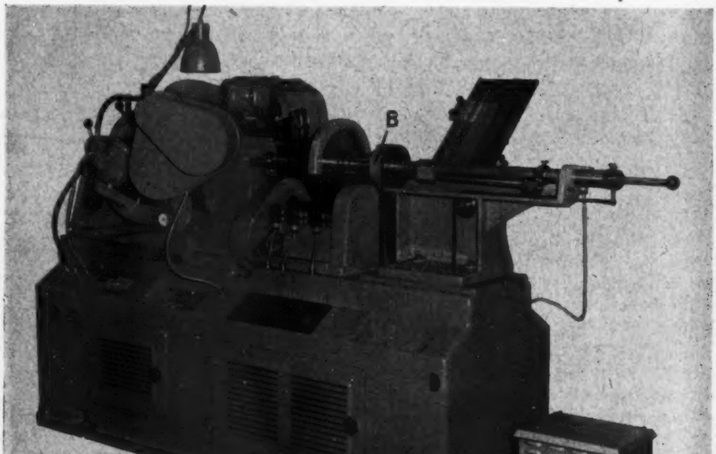


Fig. 1. Dutch-built Gefra type VM-1 fully- automatic twist drill milling machine

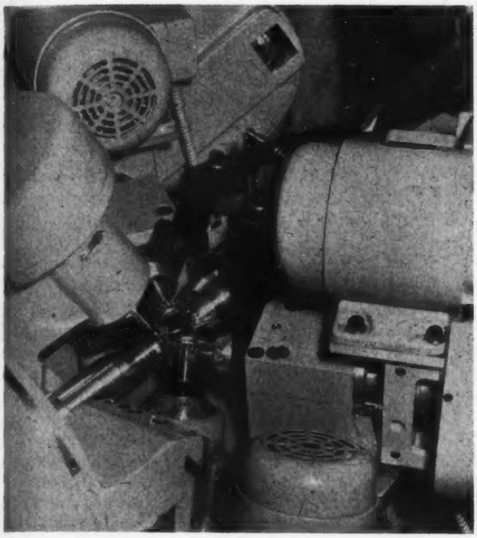


Fig. 2. Close-up view of the cutter heads for milling, simultaneously, the flutes and clearances at the periphery on a twist drill blank on the Gefra type VM-1 machine

thickness is obtained. The outer ends of the arms are held downwards by springs in contact with a block which is supported by the adjustable inclined bar *A*. A slide, which carries the bar *A* and the block, is guided in ways on the top face of the housing for the work spindle, and is attached at its right-hand end to a guard partly surrounding the large-diameter driving gear for the lead bar.

With this arrangement, the slide and the bar *A* move with the lead bar and the work spindle, independently of the block, to tilt the arms for swivelling the spindle bearing housings. At a point near the end of the milling stroke, an abutment plate at the upper end of the bar *A* makes contact with the block, and the latter then moves with the slide and the work spindle. The outer ends of the arms now ride up a steeply-inclined face on the block with the result that the cutters are moved away from each other fairly rapidly to give the required "run out" form at the shank end of the flutes on the twist drill.

When the work spindle has been brought to the end of the milling stroke, one of the arms is held by a spring-loaded plunger carried on a bracket on top of the block. At the same time, a stop attached to the guard for the large-diameter driving gear, which is now at the extreme left-hand end of its travel, operates a micro-switch to de-energize an electro-magnetic clutch in the feed drive. The switch also stops the cutters for milling the peripheral clearances, and starts a separate motor, housed in the base, which drives the barrel pinion through V-belts to impart rapid power traverse to the work spindle and lead bar assembly. For part of the rapid return travel of this assembly, the slide and the bar *A* move independently of the block, which remains connected to one of the arms by the spring-loaded plunger as previously explained. Another striker plate, at the lower end of the bar *A*, then makes contact with the block, with the result that the plunger is disengaged, and the block is caused to move with the slide. During this movement, the arms ride down the inclined face on the block, and the flute-milling cutters are re-set in readiness for the next working cycle of the machine.

During the last part of the return travel, dog-clutch teeth on the end face of a draw tube, which passes through the bores of the lead bar

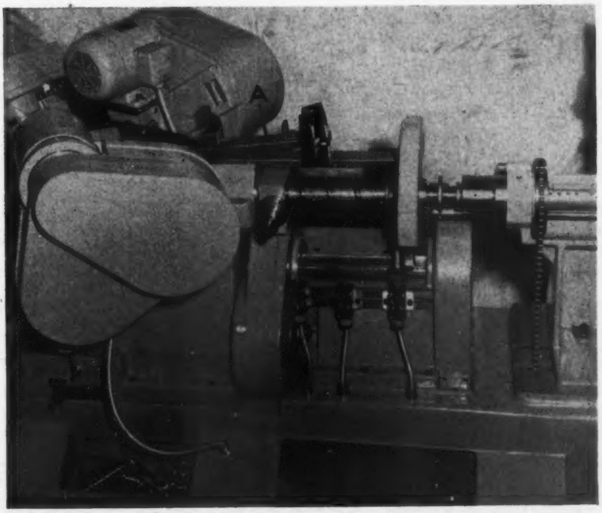


Fig. 3. In this close-up view may be seen the barrel pinion and the driving gear for the work spindle and lead bar assembly. The inclined bar *A* controls the amount of swivelling movement imparted to the bearing housings for the flute-milling spindles

and the work spindle, and extends at the right-hand side of the driving gear, engage with mating teeth within the bore of the collet-operating mechanism *B* (Fig. 1), carried at the left-hand end of the loading tube for the drill blanks. Since the lead bar continues to rotate, the draw tube is turned to open the collet to release the completed drill. Also during the return movement, a pawl carried on a pusher rod, which is connected to a shaft extension at the right-hand side of the driving gear, moves a plunger within the bore of the loading tube, in an axial direction to the right. When the collet has been opened, the pawl is swung outwards, clear of the end of the plunger, by the bevelled end of a ring attached to the loading tube, and the plunger is then moved to the left by a roller chain connected to a weight housed in the bed.

In this way, the leading drill blank of a stack, which is carried on an adjustable inclined chute, is pushed into guide bushes within the draw tube. A number of blanks is accommodated within the guide bushes, and during the movement of the plunger, the leading piece is pushed through the collet, and causes the completed twist drill to be ejected into a chute, down which it is discharged into a container at the front of the bed.

When the lead bar and work spindle assembly has been brought to its extreme right-hand position, the stop on the guard for the driving gear operates a microswitch to reverse the rapid traverse motor. Since the mating dog clutch teeth on the draw tube and the unit *B* continue to be held in engagement during the first part of the rapid traverse motion to the left, the collet is closed to grip the fresh blank. The torque applied to the draw tube when the collet is being closed is controlled by another weight, also housed in the bed, which is connected to the unit *B* by a roller chain, and with this arrangement a pre-set gripping pressure is obtained on the blank. At a pre-set point in the travel of the lead bar and work spindle assembly to the left, the stop operates a third micro-switch, with the result that the rapid traverse motor is stopped, and the electro-magnetic clutch is energized to start the feed at the beginning of the milling cycle.

During the demonstration, 3-in. long flutes and peripheral clearances were milled in a high-speed steel blank for a $\frac{5}{16}$-in. diameter twist drill in a cycle time of 47 sec. It is stated that the cycle time for milling a blank for a $\frac{63}{64}$-in. diameter drill is 68 sec.

A type F 40 twist drill milling machine, designed for operation on a semi-automatic cycle, with hand loading of blanks, is being developed, which is intended to supersede the type HM-4 and type HM-5 machines previously built by the company. These machines will handle twist drills from $\frac{31}{64}$ to $1\frac{1}{32}$ and from $\frac{63}{64}$ to $1\frac{37}{64}$ in. diameter, with flutes of 30 deg. helix angle. The largest machine in the Gefra range—the type HM-6—has a capacity for milling blanks for twist drills from $1\frac{37}{64}$ to $2\frac{3}{4}$ in. diameter, again with flutes of 30 deg. helix angle.

Trade Publications

AIR AUTOMATION, 26 Sharrocks Street, Wolverhampton, Staffs.—Well-produced catalogue describing and illustrating the firm's ranges of diaphragm/poppet valves, piston valves, air line accessories and fittings, air hose, air cylinders from $\frac{1}{2}$- to 3-in. bore, air vices, and core box air vents.

ELECTROTHERMAL ENGINEERING, LTD., 270 Neville Road, London, E.7. Leaflet describing the patented flexible electric surface heater which can be built up from standard units to any required size, and provides for heating to controlled temperatures up to 1,000 deg. C., or 1,500 deg. C. under inert atmosphere conditions.

CAMREX PAINTS, LTD., P.O. Box No. 34, Camrex House, Hudson Road, Sunderland. Illustrated 56-page booklet devoted to Camrex industrial maintenance coatings, which include corrosion resistant paints, and enamels suitable for machinery. Varnishes and special coatings are also listed.

LANDIS MACHINE CO., Waynesboro, Pa., U.S.A., (Landis Machine-Maiden, Ltd., Hyde, Cheshire). Ten-page information booklet entitled "Design A B C's of Rolled Worm Threads," which gives, with illustrations, some general rules on work design and rolling practice on Lan-Nu-Rol, Lan-Hy-Rol, and Hy-Duty cylindrical thread and form rolling machines.

IMPERIAL CHEMICAL INDUSTRIES, LTD., Fibres Division, Hookstone Road, Harrogate, Yorks. Well-illustrated booklet entitled "Terylene in Industry." Properties are first discussed, and sections are then devoted, for example, to overalls and protective clothing, conveyor belting reinforcement, coated fabrics, electrical applications, filter fabrics, industrial hose reinforcement, and V-belts.

JOHN HARPER & CO., LTD., Albion Works, Willenhall, Staffs. Informative publication (S.G.2) concerned with Harper S.G. iron. The characteristics of this material are first discussed, and sections are then devoted to tensile, high temperature, and electrical properties; recommended heat treatments; machining; design data; and applications.

JOHNSON, MATTHEY & CO., LTD. (controlling Mallory Metallurgical Products, Ltd.), 73-83 Hatton Garden, E.C.1. Leaflet 7200/3 gives particulars of the Mallory range of resistance welding electrode materials. Properties of these materials are tabulated, and sections are devoted to spot, seam, projection, and butt and flash welding; hot riveting; resistance brazing and soldering; and electroforging. In another section concerned with availability, particulars are given of a wider range of seam-welding wheel blanks in Mallory 3 which can now be supplied from stock.

Stanley Howard Machine Tool Demonstration

Stanley Howard, Ltd., 73 Devon Street, Birmingham, 7, recently staged demonstrations of some examples from the range of machine tools for which they are the selling agents.

Built by the German firm of Schwäbische Hüttenwerke, the type UF 2 Omniplex toolroom milling machine which was shown (see MACHINERY, 98/1087—10/5/61) can be supplied with a 42½- or 50½-in. long by 15¾-in. wide table. The table can be swivelled in each direction in the plane of the working surface, also tilted to the left or right and towards or away from the column through maximum angles of 30 deg. Longitudinal travel of 14⅝ in., and cross movement of 11¾ in. are provided for the table on the saddle. In addition, the table saddle can be traversed through a maximum distance of 25½ in. in the longitudinal direction, and the knee assembly through $17\frac{5}{16}$ in. vertically, by hand or power. A maximum distance of $18\frac{13}{32}$ in. is obtainable between the top surface of the table, and the centre line of the horizontal cutter spindle built into the ram-type head, which has a cross travel of $17\frac{5}{16}$ in. on guideways on top of the column. The 18 spindle speeds obtainable range from 35 to 2,240 r.p.m., the drive being taken from a 4·7-h.p. motor. Nine feeds from $\frac{13}{32}$ in. per min., also rapid power traverse, are provided by a 1½-h.p. motor. On top of the cutter head there is a turret fitted with a vertical-spindle milling head, a slotting unit, and an overarm for supporting a cutter arbor for horizontal milling, each of which can be readily swung to the working position, as required.

Also of interest was the Goliath heavy-duty centre lathe built by Eugen Weisser & Co., K.G., Heilbronn/Neckar, Germany, which has built-in equipment for automatic high-speed screwcutting. A view of the saddle and headstock of this lathe is given in Fig. 1. It will swing maximum diameters of $17\frac{5}{16}$ in. over the bed-ways and 9⅝ in. over the cross-slide, and is normally available in any of three different bed lengths, which enable a maximum of 40, 60 and 80 in. to be accommodated between the centres. The bed, which has hardened steel guideways for the saddle and tailstock, is of the sloping type, so that free discharge of swarf from the cutting tool is obtained.

Drive is taken from a 10-h.p. motor, and the 12 spindle speeds range from 31½ to 1,400 r.p.m. Alternatively, a 7½-h.p. motor can be fitted, and the 12 spindle speeds then obtainable range from 22·4 to 1,000 r.p.m. The quick-change feed gearbox provides for cutting 40 different screw threads from 2 to 28 per in., 1 to 14 mm. pitch, and from 8 to 112 d.p., also 23 threads from 0·25 to 3·5 module, without the need for change gears. There are 50 sliding and surfacing feeds, the former ranging from 0·001 to 0·031, and the latter from 0·0006 to 0·018 in. per rev.

Spindle speeds are selected by a lever in conjunction with a direct-reading dial on the headstock, and any feed within the range provided can be brought into use, merely by

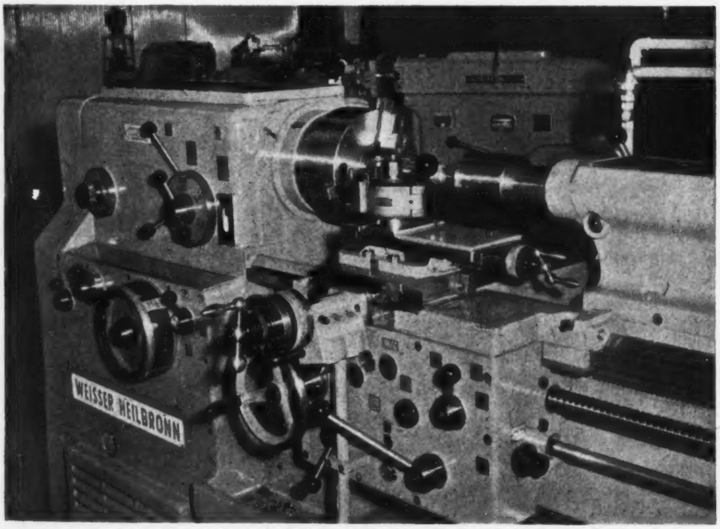


Fig. 1. A close-up view of the Weisser Goliath heavy-duty centre lathe, which incorporates automatic high-speed screwcutting equipment

turning a single drum on the feed gearbox to the required position. The sliding gears within the headstock and feed gearbox, which takes the form of a single-piece casting, are mounted on shafts of tri-lobed cross section, and are lubricated by a built-in pump. A noteworthy feature of the design is that the headstock spindle can be adjusted in the vertical and horizontal planes, to compensate for any misalignment of the work centres due to wear of the bed-ways.

Of the totally-enclosed type, the apron incorporates a sensitive safety clutch which can be disengaged to arrest feed by the action of a stop that is detachably-mounted on the bed-ways, or when a pre-set cutting pressure for turning or facing is applied. The apron gears are lubricated by a built-in pump, and lubricant for the bed-ways and cross-slide guideways is delivered by a lever-operated pump at the rear of the saddle. Push-buttons are built into a housing at the rear of the handwheel for the cross-slide traversing screw, for starting and stopping the main driving motor, which incorporates an electrical braking system.

The automatic equipment enables external and internal screw threads of right- and left-hand to be cut at spindle speeds up to the maximum available on the lathe, although to ensure accurate operation of the reversing mechanism, the saddle feed should not exceed 4 in. per min. An indexing mechanism permits multi-start threads to be cut without the need for setting the headstock spindle for angle by hand. For automatic screwcutting, the half-nuts are maintained in continuous engagement with the leadscrew, and the latter is reversed at the end of the cutting and return strokes by means of a stop on the saddle which engages collars mounted on a shaft at the front of the bed, below the feed shaft. The stop is lowered to the working position by a lever on the saddle, and the collars are adjusted on the shaft to suit the length of the thread to be cut.

Simultaneously with reversing of the leadscrew, the cutting tool is brought towards or away from the work by a quadrant mechanism built into the saddle. This mechanism is operated by a pair of stops mounted on another shaft at the rear of the bed, and serves to impart movement in an axial direction to the telescopic cross-slide traversing screw. These stops have fine adjustment, so that the movement of the cross-slide can be closely controlled in order to prevent the cutting tool from fouling the workpiece bore when it has been brought clear at the end of a cutting stroke on internal threads. The shaft is swivelled by a lever at the right-hand end of the bed when it is required to move the stops to the working position for automatic screwcutting. One of the

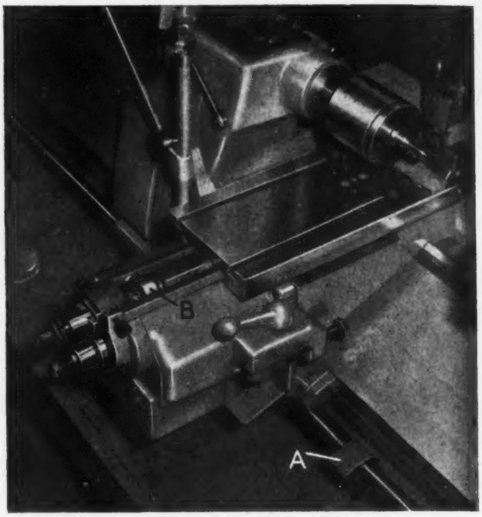


Fig. 2. In this close-up view of the saddle, from the rear, may be seen the built-in mechanism for setting and imparting increments of in-feed to the cross-slide for automatic screwcutting

stops is indicated at *A* in the close-up view Fig. 2. In this view, a cover plate has been removed from the top face of the saddle, to show the mechanism for setting and imparting increments of in-feed to the saddle.

When the cross-slide is advanced towards the work at the beginning of a screwcutting stroke, the serrated end face of the ring *B*, attached to the feed-screw, engages a chisel-shaped extension on a sleeve mounted in a bore in the end of the saddle casting. During continued movement of the cross-slide, the sleeve, the ring *B* and the feed-screw are turned as a single assembly to apply an increment of in-feed by the action between a dog on the saddle and a helical slot machined in the periphery of the sleeve. For the first part of the return movement, when the tool is being brought clear of the work at the end of the screwcutting stroke, the ring *B* moves with the cross-slide, independently of the sleeve, and the latter is then pushed in an axial direction for re-setting, by a pair of collars mounted on a reduced diameter extension on the traversing screw. The amount of "lost motion" between the collars and the end of the sleeve, and, consequently, the increment of in-feed to be applied to the cross-slide, can be varied by adjusting the collars on the extension. The

(*Continued on page* 1386)

NEWS OF THE INDUSTRY

Halifax

WILLIAM ASQUITH, LTD., Highroad Well, inform us that the overall trading position is very satisfactory. Orders from both the home and export markets are in hand for all the machine tools in the company's range, and it is stated that some 20 per cent of the output is destined for various countries overseas. Demand for radial drilling machines in the O.D.1. range, up to 7-ft. radius, is very satisfactory, and there is a steady call for the heavier type machines, from 8-ft. radius upwards. Portable radial machines are also in request, and there is a steady output of E.G.C. type fixed-arm machines for use on structural work. The 3.P.S. precision radial drilling machine, which was shown at Olympia last year, is now in regular demand. It may be noted that export orders for radial drilling machines include a number from Japan.

A large number of orders is in hand for transfer machines for the motor vehicle industry, and an order has recently been received for a special deep-hole drilling machine for export to Rhodesia.

The range of horizontal boring and milling machines up to 8-in. spindle size is also in good demand, and orders for ram type milling and boring machines, which range from 6-in. to 10-in. spindle size, include several for export to India and Japan.

The company will have a number of exhibits at the European Machine Tool Exhibition in Brussels, including a 6-in. ram type milling and boring machine, and two 3.P.S. type radial drilling machines, of 6-ft. and 8-ft. radius.

FREDERICK TOWN & SONS, LTD., Gibbet Street, are very busy with the production of their range of standard elevating arm radial drilling machines up to 8-ft. radius. An 8-ft. radius machine with a traversing bed was recently ordered, also a number of 8-ft. machines for the Admiralty, and we are informed that a steady flow of orders is being received for vertical drilling machines.

KITCHEN & WADE, LTD., Arundel Street, are fully occupied with the production of their range of machine tools, a good proportion of the output being destined for export. All sizes of standard radial drilling machines are in good demand, and there is a regular call for structural type machines.

Special machines recently ordered have included unit head types, of both vertical and horizontal designs, equipped with two, three, and four heads, and numerous enquiries are being received for special boring, drilling, and tapping machines. An order has recently been booked for a hydraulically operated multi-spindle drilling machine for use in a pipe works.

GRAHAM & NORMANTON, LTD., Dunkirk Mills, Dunkirk Lane, inform us that there is a heavy demand for standard type centre lathes of all sizes in their range, and a steady call for shaping machines. A good volume of orders and enquiries is being received for special machine tools, and keyseating and slot drilling machines are in regular request. Recent orders received have covered standard crank shaping machines up to 28-in. stroke; standard centre lathes of various bed lengths; a number of keyseating machines, including a special No. 8 size with spindle speeds up to 910 r.p.m. and a capacity for keyways up to 2-in. wide by 54 in. long; and a special lathe having a centre height of 33 in. and a 35-ft. long bed.

Work in progress includes standard lathes of 9-in., 13-in., and 17-in. centre height; a special 13-in. centre lathe equipped with a hexagon turret; and two special 17-in., extra-heavy-duty, centre lathes, with 24-ft. long beds of the raised vee type, equipped with two saddles, each with a front and a rear tool post. Each of these lathes has steplessly variable spindle speeds from 5 to 320 r.p.m., drive being taken from a 40-h.p. d.c. motor, controlled by a magnetic amplifier set. We hope to publish further details at a later date.

A. KITCHEN-D. WALKER, LTD., Hexagon Works, Pellon Lane, are busy with the production of their type E.3. (3-in. capacity) and type E.2. (2-in. capacity), elevating arm, radial drilling machines up to 6-ft. radius, and a variety of unit heads for boring, drilling, tapping, and milling. Work in progress includes a type E.3. machine with a right-angle base plate and a swivelling type table. We are informed that orders are being maintained at a satisfactory level, and include many from export markets, particularly Western Germany and the U.S.A.

The company has a development programme which will provide for additions to their current range of machine tools, and we may note that two horizontal boring and facing machines were recently built, which we hope to describe in a later issue.

A type E.3. radial drilling machine was shown at the ASTME Tool Exposition held recently in New York.

R. SUTCLIFFE.

Johansson 50th Anniversary

This year Aktiebolaget C. E. Johansson, Eskilstuna, Sweden, who enjoy a world-wide reputation, celebrate the 50th anniversary of the founding of the company by Carl Edvard Johansson. In connection with this landmark in the history of the firm a well-produced and informative book of 76 pages has been issued.

Following an introductory section by Mr. Rudolf Domellöf, the managing director, there is a list of important dates in connection with the development of the company and its products. Other articles, all of which contain valuable information, interestingly presented, appear under the titles: From Pharaoh's Cubit to Krypton's Red-orange Light; Of Men and Measure; and Measuring Methods Rationalized. Of particular significance to metrologists is an article by Mr. Bert Edenholm on "Break-throughs in Measuring Techniques." Sections of this article are concerned with the significance of reference gauges; fixed gauges; measuring instruments based on mechanical, optical, and electronic principles; pneumatic measuring instruments; and form and surface finish measurement.

There are numerous half-tone and line illustrations and several pages are devoted to high quality illustrations in full colour.

The Significance of Missile and Space Vehicle Production

(*Continued from page* 1331)

undertaken in response to the demands of the aircraft industry and might otherwise have been delayed for many years.

It is equally certain that many of the lessons that are now being learned by the research establishments and factories concerned with the various aspects of missile and space vehicle design and fabrication will be turned to account in quite different directions. There will be a wider choice of materials to withstand exacting conditions and tried methods of machining or manipulating them. Standards of machine tool accuracy will be improved, and there will be better facilities for non-destructive testing and other forms of inspection. These benefits, moreover, which will lead to improvements in many kinds of products, will not be confined to those countries where such great efforts are now being made, but will be made widely available.

Stanley Howard Machine Tool Demonstration

(*Continued from page* 1384)

collars can be set to give increments of in-feed up to 0·008 in., and for fine adjustment, the sleeve is turned within the bore in the end of the saddle by a pair of knurled screws.

The amount of cross-slide movement required for cutting the threads for the full depth can be pre-set by means of the micrometer drum on the handwheel at the front of the saddle, and a plunger within the handwheel is then extended radially. When the last cut has been applied, this plunger operates a second plunger, mounted parallel with the cross-slide screw, which, in turn, actuates the push-button switches to stop the lathe.

Industrial Notes

PRODUCTION OF IRON CASTINGS.—The Iron and Steel Board state that the production of iron castings during the first quarter of this year was 1,026,130 tons, as compared with 1,032,860 tons for the corresponding period of last year.

COCKBURNS, LTD., Cardonald, Glasgow, S.W.2, have recently been appointed selling agents in the United Kingdom for the range of pressure gauges, thermometers and special control instruments manufactured by the E.N.F.M. Company of Schiedam, Holland.

IMPREGNATED DIAMOND PRODUCTS, LTD., Tuffley Crescent, Gloucester. This company's No. 2 factory and office block, which has recently been completed, will be devoted to the production of Sparcatron spark machining equipment to meet an increasing demand. It will also enable more space to be allocated for the manufacture of diamond impregnated products.

TRUFORM GAUGE CO., LTD., Woodwards Road, Walsall, Staffs., inform us that they have recently been appointed sole selling and servicing agents in the United Kingdom for the Vetcoa thread milling equipment which is made by the Vernon Tool Co., Arizona, U.S.A. This equipment is designed as a self-contained attachment for fitting to vertical milling machines, and is available in hand-operated and fully-automatic versions.

THE BRITISH OXYGEN CO., LTD., report that a second Eagle computer-controlled cutting machine has successfully completed acceptance trials at their Edmonton works. It will now be dismantled for transport to the Barrow shipyard of Vickers-Armstrongs (Shipbuilders), Ltd., for

commissioning trials. The first machine of this type is now installed at the Wallsend-on-Tyne shipyard of Swan, Hunter & Wigham Richardson, Ltd. These machines are equipped with Ferranti magnetic tape control systems.

THE ENGLISH ELECTRIC CO., LTD., English Electric House, Strand, London, W.C.2, have received an order, valued at about £1,500,000, for the first switchgear for the new 400,000-volt "supergrid." It will be installed at the West Burton, Notts., power station.

P.M.T. (MACHINE TOOLS), LTD., Oozells Street, Birmingham, 1, have recently been appointed sole distributors in this country for S.A.I.M.P. of Italy, makers of precision lathes and milling machines. A comprehensive stock of lathes with capacities from 7 by 30 in. up to 16 by 240 in., also vertical, universal, and turret type milling machines, can be seen under power at the company's Birmingham showrooms. A technical representative has been specially appointed to cover this range of machines.

F. J. EDWARDS, LTD., 359-361 Euston Road, London, N.W.1, now represent, in the United Kingdom, Lefebvre Vaneste & Co., Gullegem-Courtrai, Belgium, for single-action, double-action, and triple-action, double-sided, hydraulic, deep drawing presses, a bulldozer, and open-fronted hydraulic drawing presses. Machines in the standard range have capacities up to 500 tons. In addition the arrangement covers L.V.D. hydraulic press brakes up to 320 tons by 12-ft. length capacity, and guillotines up to ⅜-in. by 12-ft. capacity.

Scrap Metals

MIDLANDS.—Disposal of many grades of scrap is daily becoming more difficult due to suspensions and allocations imposed by consumers. Steelworks scrap of Grades 1 and 2 can be delivered locally, but outlets are needed for the 0·04 sulphur and phosphorus scrap in steelworks sizes. Hydraulically compressed bales to No. 4 specification are disposed of readily, but No. 5 bales cannot be placed at present.

Light iron scrap is wanted in loose form but works are insisting that motor body scrap is properly cleaned and does not include copper wiring, alloy handles or any wooden attachments.

Chipped and bushy turnings are still difficult to place and prices as well as allocations are being reduced every week by one blast furnace or another. It seems inevitable that tenders for works' outputs of turnings for the six months beginning July 1 will show reductions in price.

Cast iron scrap trading is quite bright, and all grades can be placed at one foundry or another in this area. The demand for clean cylinder blocks has resulted in good prices being paid for complete engines for cleaning and stripping.

The demand for nickel bearing steels remains firm and straight nickel as well as nickel chromium scrap from local factories is cleared for consumers in the Sheffield area. Stainless steels are also wanted, prices varying according to quality.

With holidays drawing nearer it is expected that disposal of many grades will become even more difficult and merchants will have to reduce prices where scrap must be taken into stock.

Machine Tool Share Market

After displaying dullness, with a generally lower trend, for the greater part of the period under review, stock markets tended to rally, and finished on a steady note, with improvements in most sections.

The gilt-edged market, however, remained subdued, and quotations for British Funds gradually gave way owing to lack of buying interest.

Commercial and industrial share markets were moderately active, and after some sharp setbacks, the general tone steadily strengthened, and by the close a number of gains had been recorded and a few good features were in evidence as a result of favourable company statements.

Among machine tool issues, Arnott & Harrison advanced 1s. 3d. to 17s. 3d. and British Oxygen, 6d. to 24s. On the other hand, Edgar Allen lost 1s. at 43s. 6d.; Birmingham Small Arms, 4s. at 27s.; Chas. Churchill, 1½d. at 9s. 6d.; Geo. Cohen, 6d. at 14s.; Coventry Gauge & Tool, 9d. at 32s. 10½d.; Craven Bros. (Manchester), 6d. at 10s. 1½d.; Greenwood & Batley, 6d. at 26s. 6d.; Alfred Herbert, 5s. at 72s. 6d.; Newall Engineering, 1s. 6d. at 10s. 3d.; W. E. Norton (Holdings), 1s. 3d. at 10s.; Samuel Osborn, 1s. 9d. at 56s. 3d.; Ambrose Shardlow, 2s. 6d. at 66s. 10½d.; John Shaw & Sons (Wolverhampton), 7½d. at 19s. 4½d.; Sheffield Twist Drill, 6d. at 19s. 6d.; W. E. Sykes "B," 1s. 3d. at 31s. 3d.; Tap & Die Corporation, 9d. at 18s. 3d.; and Thos. W. Ward, 1s. 6d. at 82s.

CHARLES CHURCHILL & CO., LTD. Final dividend 11½ per cent, making, with the interim, a total distribution of 20 per cent for the year to March 31. This was an increase of 2 per cent on the total for the previous year.

H. W. KEARNS & CO., LTD. Int. div. 5 per cent (same).

NEWALL ENGINEERING CO., LTD. Dividend 20 per cent for the year to March 31, on increased capital, against the forecast of a maintained 17½ per cent payment.

New Companies Registered*

BENTLEY OF REDDITCH LTD., 89a Birchfield Road, Redditch, Worcs. Registered May 18, 1961. To take over business carried on as "Bentley (Redditch) Engineering Company" at Redditch, etc. Nom cap.: £6,000 in £1 shares. Director: G. Shephard.

B. & M. TOOLMAKING CO. LTD., 14 Christchurch Road, Bournemouth. Registered May 17, 1961. Nom. cap.: £2,000 in £1 shares. Directors: A. Barrett and Thos. A. Mackenzie.

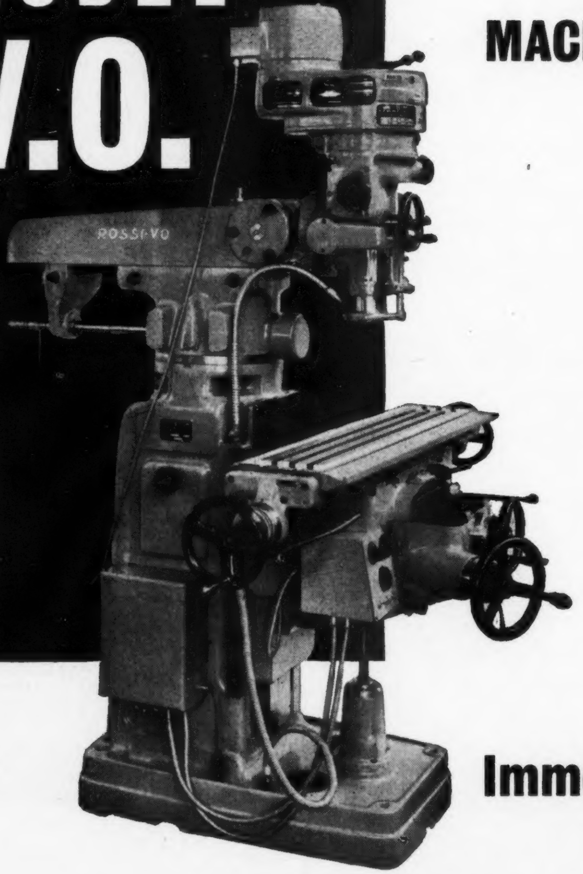
* From the lists compiled by Jordan & Sons, Ltd., Company Registration Agents, 116-118 Chancery Lane, London, W.C.2.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd	Ord.	1/-	2/6
Allen (Edgar) & Co., Ltd	Ord.	£1	43/6
" "	5% Prf.	£1	13/6*
Arnott & Harrison, Ltd	Ord.	4/-	17/3
Asquith Machine Tool Corp., Ltd	Ord.	5/-	11/6
" " "	6% Cum. Prf.	£1	16/6xd
Birmingham Small Arms Co., Ltd	Ord.	10/-	27/-xd
" " "	5% Cum. "A" Prf.	£1	14/6
" " "	6% Cum. "B" Prf.	£1	17/-
" " "	4% 1st Mort. Deb.	Stk.	90½
British Oxygen Co., Ltd	Ord.	5/-	24/-
" " "	6% Cum. Prf.	£1	20/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	10/3
Broom & Wade, Ltd	Ord.	5/-	24/9
" "	6% Cum. Prf.	£1	16/6
Brown (David) Corporation, Ltd	5½% Cum. Prf.	£1	16/-xd
Buck & Hickman, Ltd	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd	Ord.	5/-	16/3
" "	5% Cum. Prf.	£1	14/3xd
Churchill (Charles) & Co., Ltd	Ord.	2/-	9/6
" " "	6% Cum. Prf.	£1	25/4½‡
Clarkson (Engrs.), Ltd	Ord.	5/-	42/6
Cohen (George), 600 Group, Ltd	Ord.	5/-	14/-
" " "	4½% Cum. Prf.	£1	12/6
Coventry Gauge & Tool Co., Ltd	Ord.	10/-	32/10½
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd	Ord.	5/-	10/1½
Elliott (B.) & Co., Ltd	Ord.	1/-	3/7½
" "	4½% Red. Cum. Prf.	£1	12/-xd
Firth Brown Tools, Ltd	4% Cum. Prf.	£1	11/-
Greenwood & Batley, Ltd	Ord.	10/-	26/6
Harper (John) & Co., Ltd	Ord.	5/-	8/6
" " "	4½% Red. Cum. Prf.	£1	11/9

COMPANY		Denom.	Middle Price
Herbert (Alfred), Ltd	Ord.	£1	72/6
Holroyd (John) & Co., Ltd	"A" Ord.	5/-	22/6xd
" "	"B" Ord.	5/-	20/6xd
Jones (A. A.) & Shipman, Ltd	Ord.	5/-	30/-
" " "	7% Cum. Prf.	5/-	4/9xd
Kearney & Trecker-C.V.A., Ltd	5½% Red. Cum. Prf.	£1	11/-
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd	Ord.	5/-	25/-
Kerry's (Gt. Britain), Ltd	Ord.	5/-	10/7½ ex rights
Macreadys Metal Co., Ltd	Ord.	5/-	17/-xd
Martin Bros. (Machinery), Ltd	Ord.	2/-	2/6
Massey (B. & S.), Ltd	Ord.	5/-	12/-
Newall Engineering Co., Ltd	Ord.	2/-	10/3
Newman Industries, Ltd	Ord.	2/-	6/3
" "	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd	Ord.	2/-	6/-
Norton, W. E. (Holdings), Ltd	Ord.	2/-	10/-
Osborn (Samuel) & Co., Ltd	Ord.	5/-	56/3
" " "	5½% Cum. Prf.	£1	23/-
Pratt (F.) & Co., Ltd	Ord.	5/-	18/9xd
Sanderson Kayser, Ltd.	Ord.	10/-	40/-
" "	6½% Cum. Prf.	£1	17/-
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	12/3
Shardlow (Ambrose) & Co., Ltd	Ord.	£1	66/10½
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	19/4½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	19/6xd
" " " "	5% Cum. Prf.	£1	14/3
Stedall & Co., Ltd	Ord.	5/-	8/7½
Sykes (W. E.), Ltd	"B" non-voting Ord.	10/-	31/3
Tap & Die Corporation, Ltd	Ord.	5/-	18/3
" " "	4½% Deb. 1961-1977	Stk.	82½
Wadkin, Ltd	Ord.	10/-	26/-
Ward (Thos. W.), Ltd	Ord.	£1	82/-
" "	5% Cum. 1st Pref.	£1	14/-
" "	5% Cum. 2nd Pref.	£1	22/6
Willson Lathes, Ltd	Ord.	1/-	3/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

ROSSI MODEL V.O.



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- TABLE WORKING SURFACE $47\frac{1}{4}'' \times 9''$
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- **Single hose supply**
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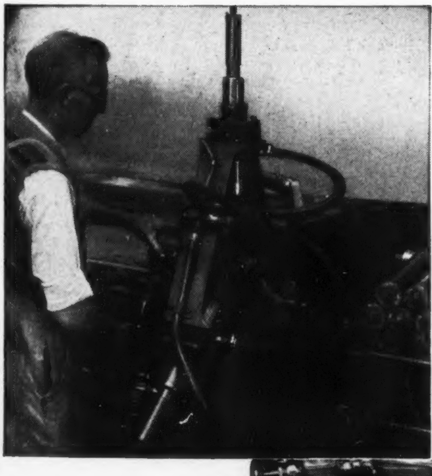
- **Break through control**

The 'Selfeedril' is a self-contained unit head with built in forward and reverse mechanism, rapid approach and feed speed adjustment. Only one air hose is needed to supply each unit, and control is by a single elementary on-off valve. Maximum chuck capacity ¼" dia. Forward feed 1½" and 2½"

Photograph by courtesy of Richard Sutcliffe Ltd.



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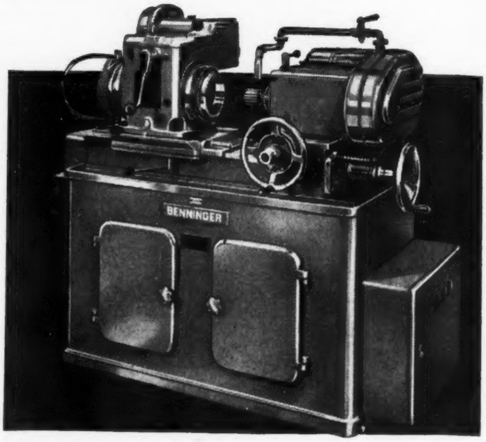
BENNINGER (Swiss) UNIVERSAL THREAD MILLER GFU 16



Almost any thread form can be produced and by semi-skilled labour — external or internal, right-hand or left, parallel or tapered, in blind holes or up against flanges, accurately to the last thread — and worms.

For diameters ·16″ to 9·45″ external, ·4″ to 13·98″ internal. Spindle bored 6·3″ right through. Max. thread length: with leader and follower 2·8″, with leadscrew 14·5″. Pitches 50 to ·5 t.p.i. Cutting times 38 sec. to 19½ min.

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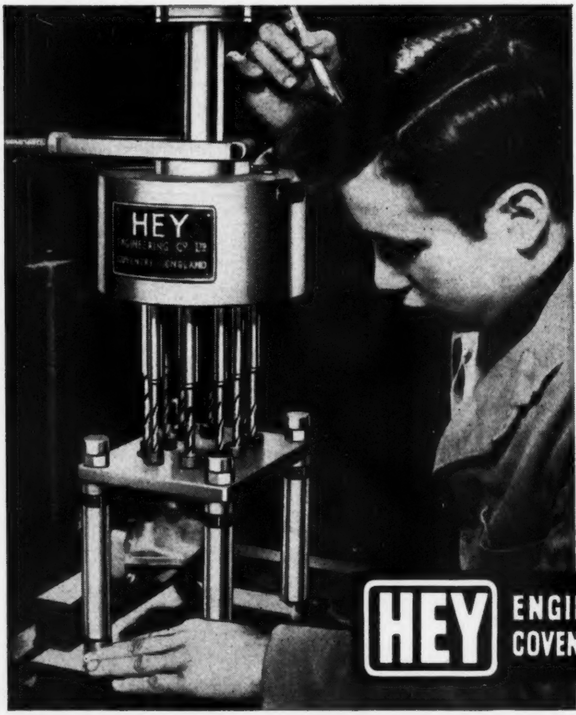
See this machine at our showrooms and ask for illustrated brochure M/234



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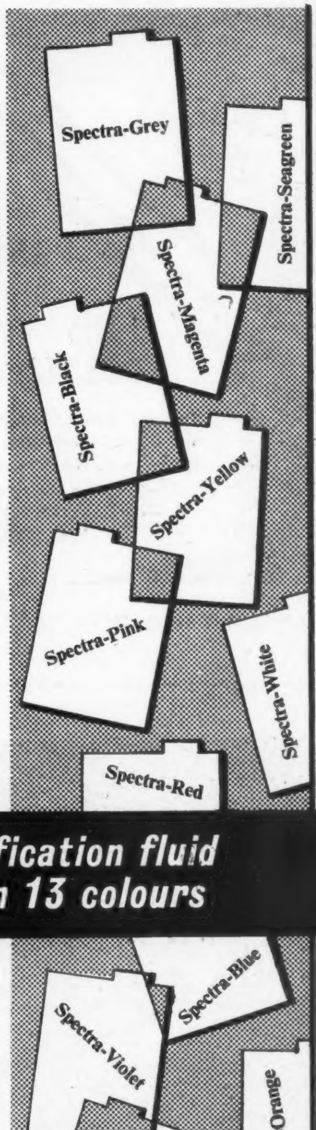

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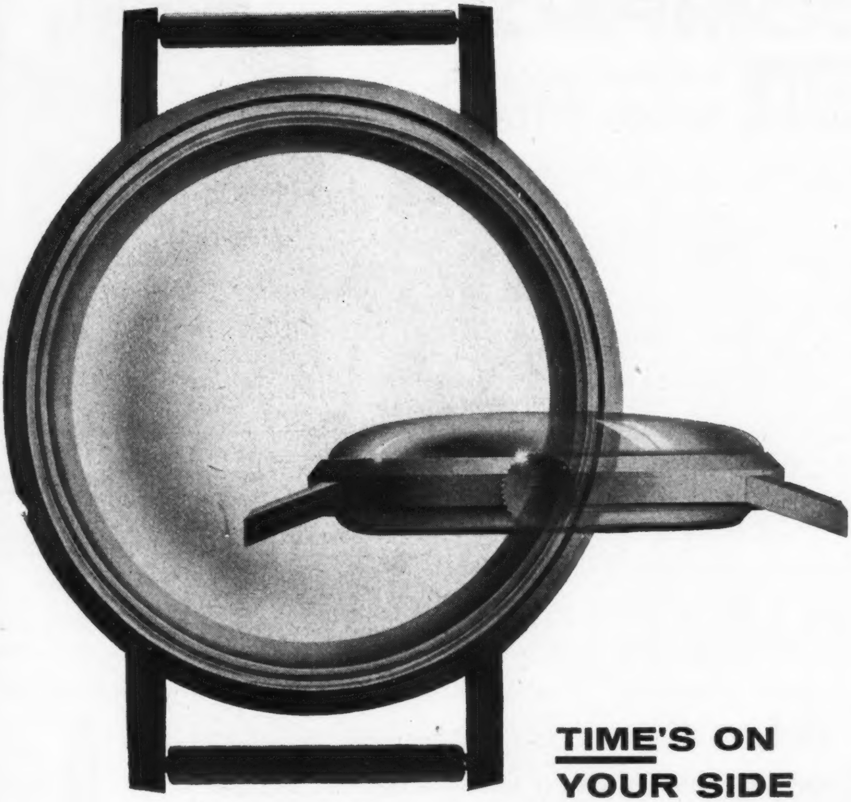

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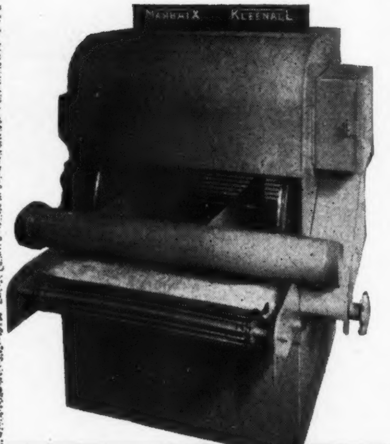

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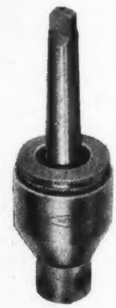
- **"B" Type suitable for Capstans**



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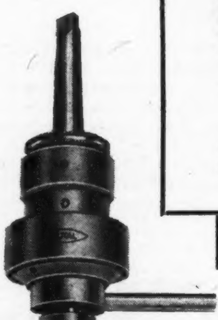

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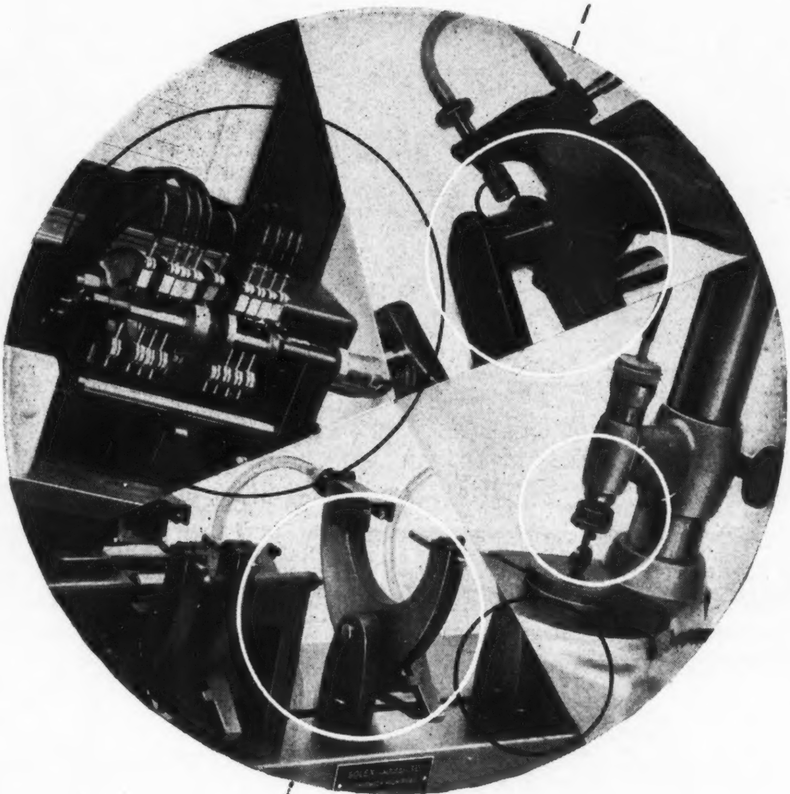

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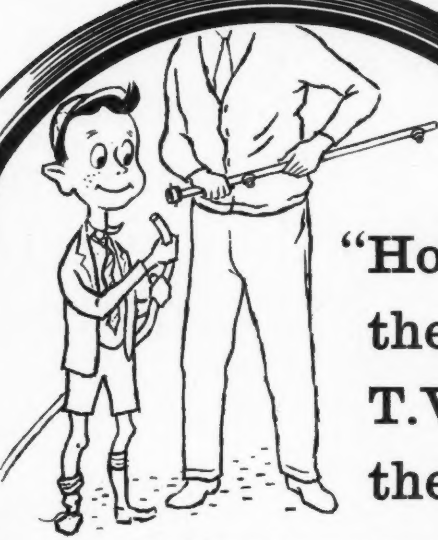

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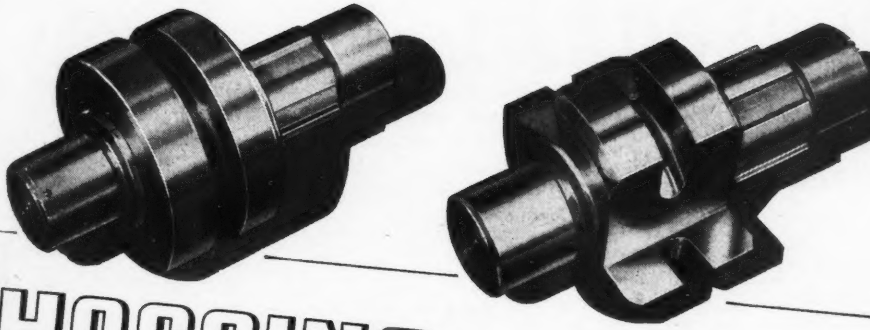

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In the well-equipped works of Herbert Morris Ltd. Loughborough, this CUNLIFFE & CROOM horizontal shows to advantage on the milling of wheel shafts.
These machines, with their massive rigidity and ample power, are capable of real 'hogging' or carrying out light finishing with the utmost precision.
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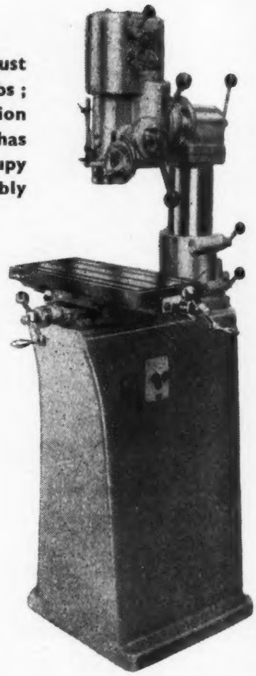

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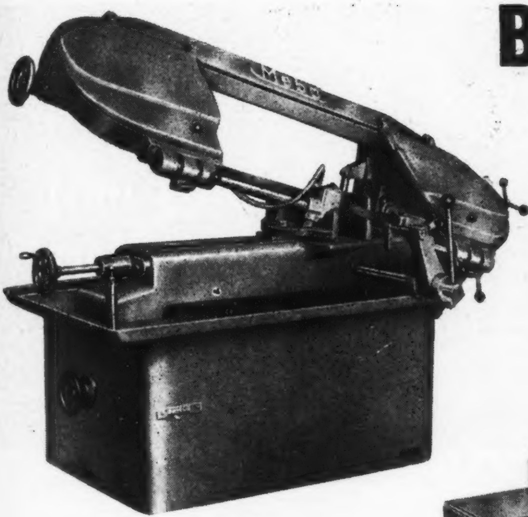

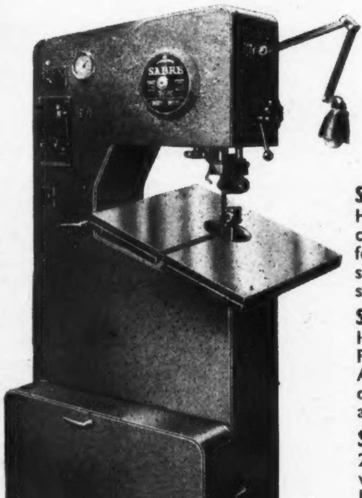

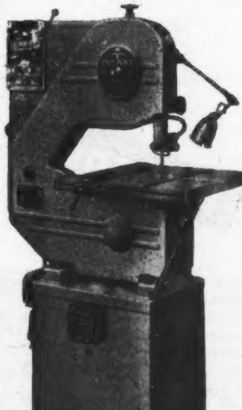

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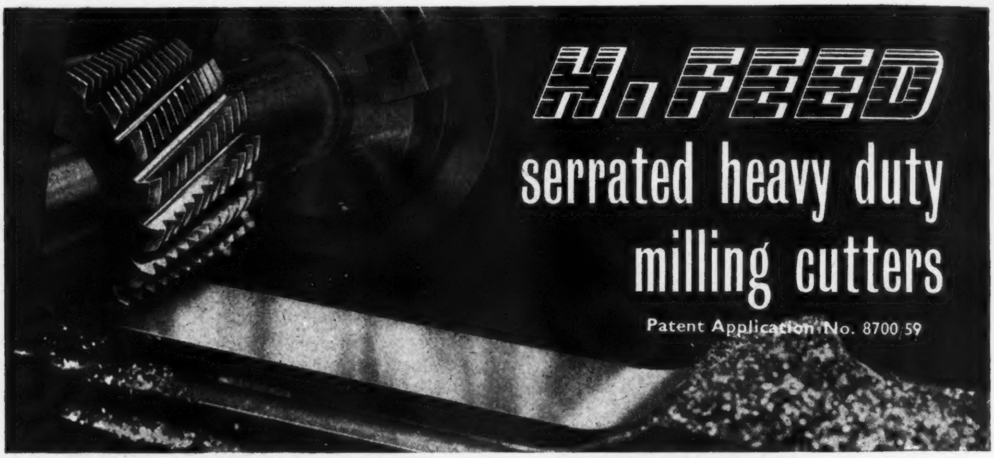

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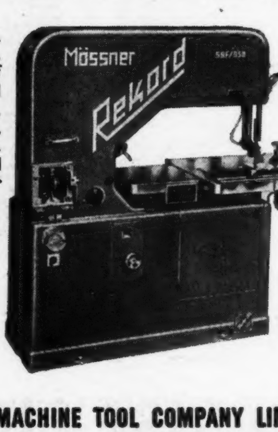

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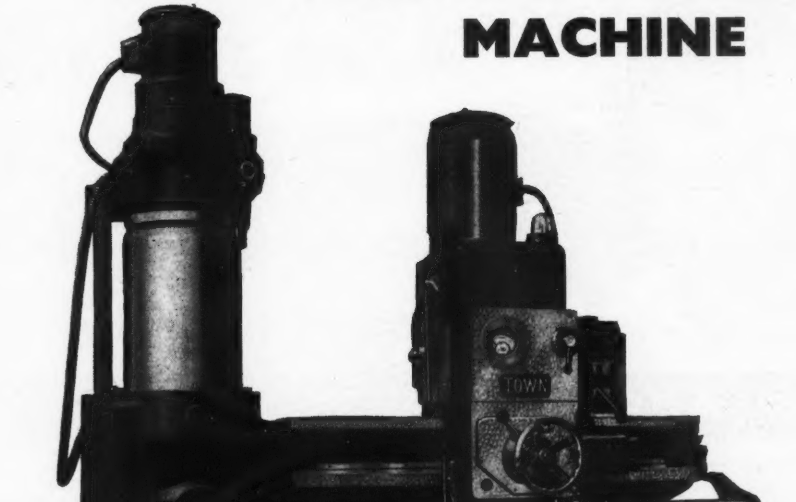

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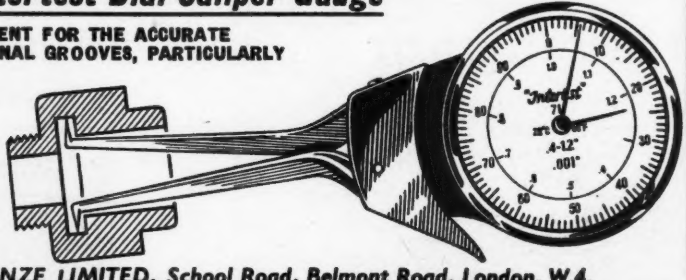
76	2·4"-3·2"



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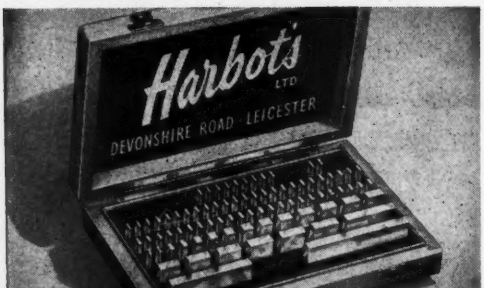

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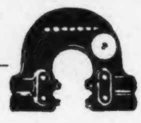

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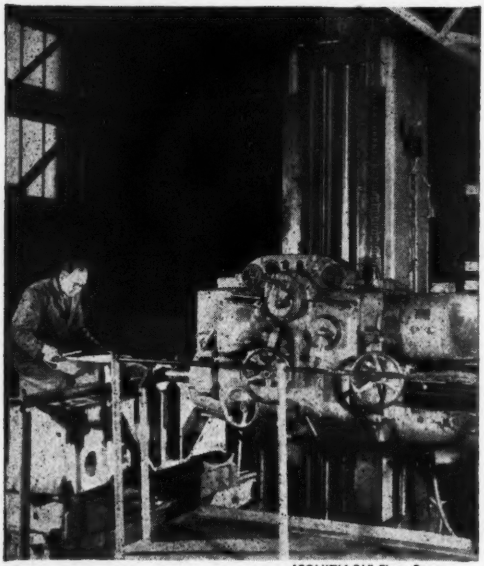

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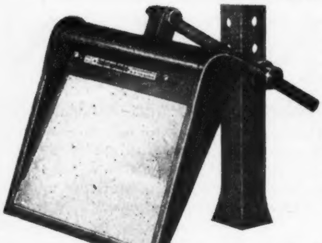

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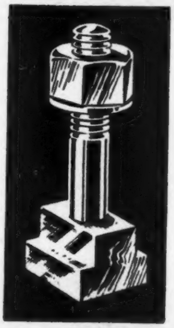

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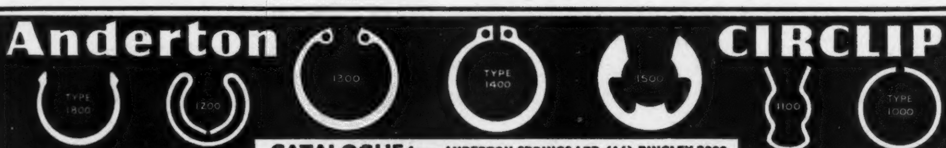

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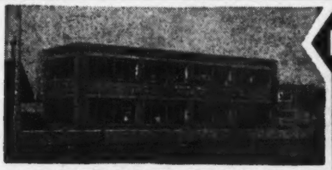

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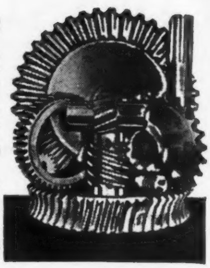

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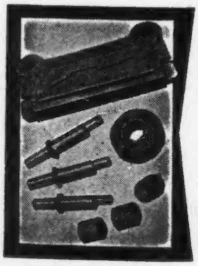

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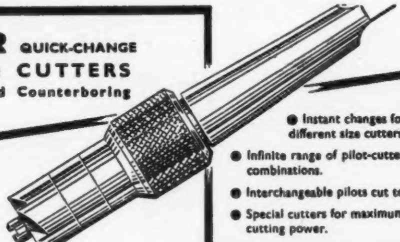

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WARD No. 16, covered bed, 8½in. spindle, 32in. 4-jaw chuck, rapid and power feeds to saddle, cross slide and turret, power rotating turret, spindle speeds 7-225 r.p.m., 50 h.p. motor.

WARD No. 8, covered bed.

WARD No. 10B, covered bed. 4½in. spindle power rotating turret, power and rapid feeds to turret only, collet head and bar feed.

DRILLING MACHINES

ASQUITH O.D.1 5ft. Radial, with loose box table.

AVEY 2-spindle drill, pedestal base, ½in. capacity.

HORIZONTAL MILLERS

SUNSTRAND No. 2 Electro Mill, auto. cycle, 12in. by 54in. table.

HERBERT No. 3ND. Plain.

EDGWICK No. 2, 11in. by 42in. table, No. 40 steep taper.

JONES & SHIPMAN duplex slot miller. Hydraulic feed.

VERTICAL MILLERS

WADKIN high speed for light alloy, 16in. by 40in. table.

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B.S.A.-Landis, 6in. by 18in. plain hydraulic cylindrical grinder.

BROWN & SHARPE No. 2 Surface Grinder, 18in. by 6in.

TAPPING MACHINES

HERBERT No. 2 Flash Tapper, ½in. capacity.

All machines motorised 400/3/50 unless otherwise stated.

SERVICE **EDWARDS** VALUE!

TWO **BRITISH CLEARING** No. DH-55-35-30. Double Sided Double Action Hydraulic Presses with steel plate frame. Pressure exerted, punch 55 tons, blankholder 35 tons. Max. pressure by both slides, 90 tons. Punch stroke adjustable up to 8in. Blankholder stroke adjustable up to 4in. Width between uprights 32in. Bed 32in. × 30in. Blankholder 26in. × 30in. Hole in blankholder 21in. × 21in. Cushioned bed. With all hydraulic equipment including pump. Motorised 400/440/3/50.

TAYLOR & CHALLEN No. 3½DGDP. Double Sided Double Geared Double Action Cam Drawing Press. Punch stroke 10in. Blankholder stroke 5¼in. Between uprights 22in. Bed 20in. × 19¾in. Blankholder 12in. dia. Punch 5in. dia. Bed fitted with ejector. Operator's guard. Arranged motor drive 400/440/3/50.

BLISS No. 85. Double Geared Double Sided Reducing Press with straight sides. Pressure about 50 tons. Stroke 14½in. Between uprights 22in. Bed 21in. × 21in. Hole in bed 9½in. dia. Spare crankshaft with 5in. stroke. Friction clutch. Arranged motor drive 400/3/50.

BLISS No. 18 Inclinable Press with single roll feed. Pressure about 8 tons. Stroke 2in. Centre to back 3¾in. Bed 14in. × 8¼in. Length of feed variable 0–2¼in. Size of knurled feed rollers 2in. dia. × 2in. wide. Arranged motor drive 400/3/50.

DOUBLE SIDED Friction Screw Press with cast steel frame. Pressure about 250 tons. Max. stroke 14in. Dia. of screw 8¾in. Width between uprights 22¼in. Tee slotted bed 19¾in. × 20¾in. Tie bar construction. Arranged motor drive 400/3/50.

NEW LEN. 63/280. Open Fronted Geared Inclinable Power Presses with adjustable stroke from 13/16in. to 4 5/16in. Pressure exerted 63 tons. Depth of throat 11in. Size of table 20¾in. × 29 13/16in. Arranged motor drive 400/440/3/50.

HOLROYD Motorised Toggle Action Rivet Punching Machine with power lift to table. Capacity ¾in. diameter rivets. Stroke of ram 3¾in. Depth of gap 5in. Arranged motor drive 350/400/3/50.

Photographs of the above are available.

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Further details from:—
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10in. × 24in. Churchill Model PAH Hydraulic Universal Tool and Cutter Grinding Machine with rise and fall wheelhead. Fully m/d 400/3/50. Variable hydraulic motion 6in.-180in. per minute.—LEE & HUNT, LTD., Crocus Street, Nottingham. Tel.: 84246.

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RICHARDS 48in. Vertical Borer.
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LANDIS 10in. × 24in. Universal Grinder.
STANLEY 8½in. × 48in. S.S. & S.C. Lathe.
ARCHDALE 20in. Horizontal Miller.
ARCHDALE 18in. Vertical Miller.
CINCINNATI 4/36 hydromatic Miller.
PRATT & WHITNEY Thread Miller 4½in. × 12in.

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BESCO Treadle Operated Guillotine, 6ft. × 18 gauge cap. £90
BESCO Treadle Guillotine, 4ft. × 18 gauge D. £75

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MILWAUKEE No. 2 Horiz., 50in. × 14in. table. £475
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BUTLER Planing Machine, 9ft. × 2ft. 6in. table. £1,100

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Double Ended Angle Cropping Machine· Cap. up to 6in. × ⅜in. angles.

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Edwards 6ft. × ¼in. Swing Beam Folder.

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New **NORTON** 10in., 12in., 14in., 16in., and 20in. D/E Tool Grinders.
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CINCINNATI Model 3 OM. Single Dial Type High Speed Vertical Milling Machine. Table 62½in. × 15½in., speeds 18 to 1,300 r.p.m.

WARD No. 13 Combination Turret Lathe, covered bed 25in. concentric chuck, 27in. 4-jaw independent chuck. Good turret tooling, taper turning attachment, 35 h.p. motor 400/3/50. Modern Machine, Excellent equipment.

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SWIFT 12½in. Centres Gap Bed S.S. & S.C. Lathe, 6ft. between centres, 400/3/50.

SWIFT 11in. Centres S.S. & S.C. Lathe. 6ft. between centres, with taper turning attachment.

DENHAM 9in. Centres S.S. & S.C. Lathe, 4ft. 6in. between centres, with taper turning attachment.

NORTON Model "C" 14in. × 36in. Hydraulic Universal Cylindrical Grinding Machine. Excellent Equipment including Internal spindle, etc.

DAVID BROWN Model MT.30 Spur and Spiral Gear Hobbing Machine. Capacity 30in. dia. × 8in. face or 11½in. dia. × 12½in. face, 3 D.P. Full changewheels.

PFAUTER 24in. Universal Gear Hobbing Machine. Plain and Tangential feed hob slide.

PFAUTER Hob Grinding Machine.

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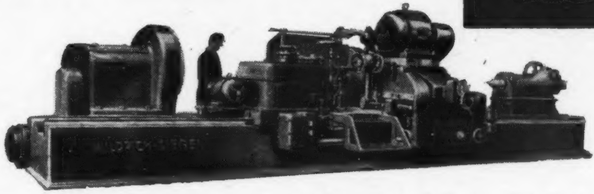

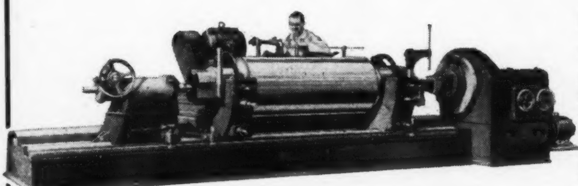

"WALDRICH SIEGEN" model WS 2B traversing wheelhead type roll-grinding machine, with built-in variable automatic cambering mechanism for producing both concave and convex cambers on the roll surface.

Maximum diameter of roll ground	38in.
Maximum length of roll face ground (with heavy duty roll supports in position) ...	8ft. 4in.
Maximum length of roll face ground (without supports)	13ft.
Maximum distance between centres	13ft.
8 workhead speeds	6-57 r.p.m.
Workhead motor...	10 h.p.
Wheel size	24in. by 3in.
Wheelhead motor	20 h.p.

Headstock has 24in. diameter faceplate, with a special driver for driving the "wobblers" of steel mill rolls. Overall floor space required for the machine is 25ft. by 9ft.

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WERNER Model 3·275 Spline Shaft Grinding Machine—capacity 3½in. dia. by 64in. long.

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RICHARDS 'Victor' 30in. Vertical Boring and Turning Mill with side head.

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ZOCCA Type RPAT 650 Surface and Cylindrical Grinding Machine—capacity 10in. by 24in.

ALEXANDER No. 3A Universal Die Sinking Machine—capacity 16in. by 6in. by 4in.

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OERLIKON Type Isofil 2 Thread Milling Machine—capacity 8in. dia. by 79in. long.

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STIRK 16ft. by 5ft. by 5ft. double column Planers, four toolboxes; modern machines with Lancashire drive (Two).

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BESCO 42in. by 10 s.w.g. Power Guillotine.
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TORPEX 22in. Shaping Machine.
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ALBA 6S 24in. Shaper.

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MIKRON No. 79 Gear Hobber (almost new).
Two **SAFAG** Model 24 Cutter Relieving Machines.

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DIMCO

DRUMMOND Model K Chucking Capstan Lathe.
10in. × 24in. **CHURCHILL** Universal Grinder.
No. 3 **GISHOLT** Bar Feed Capstan Lathes.
U.3 **VICTORIA** Universal Milling Machine with Vertical Head. As new.
No. 2 D.F. **SCRIVENER** Centreless Grinding Machine.
36in. × 10in. **FRITZ WERNER** Vertical Milling Machine, swivelling head.
P.24 **SNOW** Surface Grinder.
New—8in. **GEMINIS** Toolroom Lathe, without Copying Attachment.
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4ft. **ASQUITH** Universal Drill. Portable.
8½in. **LANG** S.S. & S.C. Lathe, 4ft. between centres.
New 7in. **WOODHOUSE & MITCHELL** Type 70 Junior Lathe.
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16in. **BLANCHARD** Rotary Surface Grinder.
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KEARNS No. 2 Standard Horizontal Boring Machine with facing head and sliding spindle. 400/3/50.
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ARCHDALE 28in. Horizontal Manufacturing Milling Machine, with power and rapid feeds. Table size 49in. × 30in. 400/3/50.

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Further details from:—
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1 New Wickman Erodomatic Model W/8M Series 111 Machine with all electrical equipment. Extra equipment: Depth stop incorporating scale, dial indicator and automatic knock off switch.—BOX D25, MACHINERY, Clifton House, Euston Road, N.W.1.

Bechler 16mm. sliding head automatic, 400/3/50, combination att., gears, barfeed, Ex. Cond.; also Peterman 10. HS, combination and diehead atts., equipment, late model.—C. L. THOMAS LTD., Stirling Road, Solihull. Tel.: 3075-6.

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Herbert Carbicut Lathe, 16 spindle speeds 445 to 3,025 r.p.m. 3 feed changes 70, 105, 140. 1¼in. dia. spindle bore. 5 h.p. motor, 400-440/3/50.—BOX C910, MACHINERY, Clifton House, Euston Road, N.W.1.

Essex No. 32 Punch Shaper, Adjustable stroke 52, 36 and 65 strokes per min. Swivel of tool adjustment 0-90 deg. Dividing Head. In "as new" condition.—BOX C935, MACHINERY, Clifton House, Euston Road, N.W.1.

Butters Bros. Derrick Crane 3 tons capacity, 90ft. 0in. jib, cabin type. All electric and in excellent condition.
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Herbert No. 4BS Capstan Lathe. Full Turret Equipment, etc.
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Semi-Automatic Thread Milling Machine by Hanson Whitney. Capacity 4in. dia. × 9in. long. Collet capacity 2in. External cap. 4in. dia. max. with 2in. cutter. Internal cap. ⅜in. dia. min. with ¼in. cutter. Some equipment available.—BOX C931, MACHINERY, Clifton House, Euston Road, N.W.1.

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ROBOT 6in. × 18in. Surface Grinder.
NEWMAN 10in. × 24in. Universal Grinder.
BROWN & SHARPE No. 2 Surface Grinder.
HORTSMAN Thread Grinder, capacity 5in. dia. × 9in. b.c.
BROWN & SHARPE No. 5 Cylindrical Grinder.
FRITZ WERNER Model 270A Cylindrical Grinders, 3½in. × 7in. b.c.
BROWN & SHARPE No. 13 Universal Grinder.
BRYANT No. 5 Heavy Duty Internal Grinder.
BENTLEY Form Cutter Grinder.

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D.S.G. 8½in. × 48in. Gap Bed, 19-418 r.p.m.
D.S.G. 8½in. × 30in., 11-490 r.p.m.
HOLBROOK 8in. × 36in., 11-400 r.p.m.
COLCHESTER MASTER 6½in. × 36in. Ainjest Screwing Attachment.
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EMPIRE 6½in. × 40in. Lathe.
SOUTHBEND 5in. × 24in. Bench Lathe.
BOYES & EMMS S.S. & S.C. Lathe, centre height 16in. × 7ft. 6in.
ROLLO 6½in. Centre Lathe.
HENDY 13in. × 30in. S.C. Lathe.
RIVET 4in. × 18in. b.c. Precision Lathe.
WARNER & SWASEY No. 3 Capstan.

MILLERS

CINCINNATI 8in. × 18in. Tool and Die Miller.
EDGWICK No. 2 Universal, 46in. × 11in. table, 24-405 r.p.m. Vertical Attachment Dividing Head.
TRIDENT Vertical, table 30in. × 8in., 75-750 r.p.m.
CINCINNATI 1-18 Production Miller.
KENDALL & GENT Vertical Miller, table 69in. × 19in., speeds 20-300, rapid traverses.
SCHIESS DEFRIES Vertical Keyseater.
MAMMUT 10in. × 23in. Table Horizontal Mill, hand lever operated.
FRITZ WERNER 10in. × 34in. Horizontal Mill.
BROWN & SHARPE No. 2 11in. × 49in. Horizontal Mill, speeds 15-376. Feeds 3/10-15 I.P.M.

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INVICTA 5m. Shaper.
ORMEROD 8in. Toolroom Slotter.
CHURCHILL-REDMAN 32in. Stroke Heavy Duty Shaper. Excellent condition.
ESSEX No. 32 Punch Shaper.
30-ton **RASKIN** Double Sided Double Geared Drawing Press. Area 20in. × 23in. Draw 4½in.
New **POREBA** Model HDA.80 Planer, capacity 10ft. × 32in. × 30in. table, drive by Heid gearbox.
DOWDING V8 Gear Hobber.

DRILLS

POLLARD 4-spindle Pedestal Drill, 2-2MT 2-3MT.
POLLARD 3-spindle Pedestal Drill, 3MT, 110-1,455 r.p.m. Power Feed.
POLLARD 13 AX Pedestal Drill.
PROGRESS 4E Pillar Drill.
TAUCO ½in. Bench Drill.
BOLEY Multi Drill VB 10in.
CORONA 13in. 2AP Sensitive Pedestal Drill.
CORONA 20in. Pedestal Drill.
15HEF 4 Spindle Drill.

MISCELLANEOUS

CANNING Double Ended and Centreless Polishing Machines.

MACHINES NOW IN STOCK

TATE

BORING MACHINES

RICHARDS 72in. Double Column Vertical Boring and Turning Mill.
PADDON MK3 type WP Cylinder Re-boring Machines.
PERRIN Model AV-1 Miniature Jig Borer (almost new).

CAPSTANS AND TURRET LATHES

BOLEY-LEINEN Model ER15 ¾in. Capstan (modern).
HERBERT No. 2 Pre-optive Bar Turret Lathe, Flamard bed, 2in. capacity with bar feed, full turret tooling.
LIBBY 2H 8in. spindle Turret Lathe.
MURAD Model 3Q ¾in. Capstan Lathe.

CENTRE LATHES

LANG 10½in. by 10ft. between centres Centre Lathe, with taper turning.
SOUTHBEND 7in. Centre Lathe.

DIESINKING MACHINES

NASSOVIA Model V.11 Hydraulic Diesinker. Mould capacity 27½in. by 19½in. by 23in. height. (Unused.)
VICTORIA Duplomatic Hydraulic Copy Milling Machine, 8in. by 8in. (NEW).

DRILLING MACHINES

Two **CORONA** Model 31A Heavy Duty Pillar Drills.
CRAFTSMAN ½in. Bench Drills; four at £25 each.
Various **ACIERA** Precision Bench Drills.

GRINDING MACHINES

LAMBERT Model 73 Watchmaker's Cutter Grinder (two).
CRAVEN Heavy Duty Roll Grinding Machine with capacity for rolls 42in. dia. by 12ft. between centres and fitted with automatic cambering. Will take rolls up to 25 tons weight. Fully motorised machine of modern design. WEIGHT 25 tons.
CINCINNATI No. 2 Tool and Cutter Grinding Machine.
COVEL No. 2 Tool and Cutter Grinding Machine.
MATRIX No. 16G Plain Straight Thread Grinder.
MATRIX No. 6 Internal Thread Grinders, 3in. by 10in.
HEALD Model 81 Sizematic Internal Grinder.
WOLTERS Model I.L.1 Hydraulic Internal Lapping Machine.
PETEWE Model 3D Profile Grinding Machine. (Nearly new.)

MILLING MACHINES

EDGWICK No. 2 Vertical Mill.
VICTORIA Duplomatic Hydraulic Diesinking Machine (almost new).
FRITZ WERNER No. 3230 Precision Vertical Milling Machine, 24in. by 8in. table, longitudinal and cross power feed to table.
EDGWICK No. 1 Horizontal Milling Machine, 40in. by 10in. table.
Four **DENBIGH** Model No. C4 Horizontal Milling Machines.
VICTORIA Junior Mill (new).
SANT ANDREA Model U.F.O/5 Extra heavy duty Horizontal Miller, 86½in. by 19in. Table travel 67in.
VICTORIA Model U1 Universal Milling Machine of latest type, in excellent condition.
VICTORIA Junior Omnimil (New).
Two **ARCHDALE** 18in. Automatic Cycle Kneeless Production Millers.
MILWAUKEE Model 2CE Horizontal Miller (dial type) (nearly new).
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ASQUITH Model 28V Vertical Milling Machine, table 50in. by 15in.

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ESSA Type PL 6.000kg. High Speed Precision Double Sided Press (five machines).
RHODES 3-ton Open Fronted Bench Press with flange motor and **UDAL** guards.
LEE & CRABTREE 15-ton Honing Press.
LEE & CRABTREE 20-ton Honing Press.
LEE & CRABTREE 35 Double Action Mechanical Press.
BLISS Model 20B 27 tons Power Press.
H.M.E. Model DCP3 70-ton Double Sided, Double Crank, Single Action Power Press.
New **MULLER** Model AMP 15-ton Power Press.
Three New **MULLER** Model AMP 22-ton Power Presses.
Three New **MULLER** AMP 35-ton Power Presses.
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BROACHING
AMERICAN Model H2, stroke 3pin.
CAPSTANS
HERBERT 2S.
MURAD $\frac{3}{8}$in.
HERBERT 4B.
DRILLS
DENBIGH 24in. B.G.
HERBERT " C " Power Feed.
CORONA No. 21 AR, No. 3 M.T.
JONES & SHIPMAN 816, $\frac{3}{16}$in. cap.
CORONA 1AX, No. 1 Morse Taper.
CORONA 15HF, $\frac{3}{16}$in. cap.
LELAND GIFFORD 2-sp., No. 2 M.T.
HERBERT Type B. Single Spindle, $\frac{1}{2}$in.
CORONA 6MX Cluster Type.
HERBERT Type H, $\frac{1}{2}$in. dqp.
CORONA 12AX, $\frac{5}{16}$in. cap.
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LIENHARD 3 Dimensional (New).
LIENHARD No. 1H.
HUPFIELD Router.
T.T. & H. Type C, C.B. and M.A.
T.T.& H. Multi Etcher.
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JONES No. 13 Bandsaw.
Wickstead No. 1 Hacksaw.
RAPIDOR 6in. Hacksaw.
RAPIDOR Filing.
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GEAR CUTTERS
SAFAG Pinion.
MAXICUT 7in. × 2in. × 6 D.P.
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CAPCO No. 2, 14in. × 6in.
CHURCHILL OSB 8in. × 30in.
LUMSDEN Vert. 210 XXM.
SNOW Table, 20in.
ABRASIVE No. 34 Vertical Spindle.
ABRASIVE No. 1$\frac{1}{2}$in. hand.
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BRYANT 16/38 and 5.

GRINDERS (Cylindrical)
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CHURCHILL PBH 12 × 36in. Uni.
NEWALL 6 × 18. Model XL.
PRECIMAX MPB 10 × 48.
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JONES & SHIPMAN, 10in × 27in., T. & C.
J. & S. Drill, $\frac{1}{8}$in. to $\frac{7}{8}$in.
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TAUCO 10in. Abrasive Cut Off.
ROWLAND 12in. × 2in. Single Wheel.
ABWOOD Carbide.
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KEYSEATERS
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EDGWICK 4in.
LATHES
DENHAM 4$\frac{1}{2}$in. × 24in. S.S. & S.C.
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DENBIGH Type C4. Table 46 × 10.
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KENT OWEN 1/8 Production.
HARDINGE Precision. Table 25 × 6$\frac{1}{2}$.
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JONES 225 Univ. Table 22 × 6.
ARCHDALE 20in. dial. & 14in. mfg.
RICHMOND O3. Table 40 × 10.
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MILLERS (Vertical)
C.V.A. 79 Tool and Die.
PALLAS VI. Table 30 × 8$\frac{1}{2}$.
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WRIGHT Clicking Press.
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PROFILING MACHINE
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JONES FB1, 4ft. between centres.
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One Secondhand Scrivener No. 1 Centreless Grinding Machine, maximum capacity 1$\frac{1}{2}$in. diameter with Plunge Feed. Hand Operated. Motorised 400-440/3/50.
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Alba 24in. Shaper. Ormerod 18in Shaper.—C. DUGARD, LTD. Denmark Villas, Hove 32471

Cincinnati No. 3 Vertical Milling Machine. Speed Range 18-1,300 r.p.m. Dial Type.
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Coulthurst 9$\frac{1}{2}$in. and Lang 8$\frac{1}{2}$in. All Geared Head Surfacing and Boring Lathes, 400/3/50.—HICKS MACHINERY, LTD., 26, Addison Place, London, W.11. Tel. PARk 2333.

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Box Tables, cast iron, for sale. 79$\frac{1}{2}$in. × 23$\frac{1}{4}$in. × 28in. Machined short ends and two opposite sides. Other two sides open. Ends have 1$\frac{1}{16}$in. diameter holes, sides have slots 8in. × 2in. and 3in. × 2in. Well ribbed. Photo.—F. J. Edwards LTD., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

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RE: WALTER INSTRUMENTS LIMITED.

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including
S.S. & S.C. AND CAPSTAN LATHES
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Messrs. LINKLATER & PAINES, Solicitors, 59, Gresham Street, London, E.C.2, and of
Messrs. HENRY BUTCHER & Co., Auctioneers, Valuers and Surveyors of Factories, Plant and Equipment, 73, Chancery Lane, London, W.C.2.
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Brown & Sharpe OOG ½in. Cap. Auto Screw Machine, Serial No. 14537. Complete Bar Feed and Turret Equipment, etc.

Further details from:—
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Churchill Cylindrical grinder, 18in. × 6in. hydraulic trav. Hydrauto bearings, 400/3/50, also Brown and Sharpe No. 5, cyl. 4in. × 10in. ex. cond.—C. L. THOMAS LTD., Stirling Road, Solihull. Tel.: 3075-6.

Kitchen & Wade H.3 Horizontal Boring, Drilling and Milling Machine, with 9ft. 0in. Square Table and Auxiliary Table. New 1956. Excellent condition.
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by "Herbert" & "Ward"
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HONING, ROTO, FINISH AND WELDING MACHINES
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CONSIDERABLE STOCKS AND STORES

Catalogues (when ready) may be obtained of:
Messrs. ROOKE, LANE & CO., Chartered Accountants, 2, Norfolk Street, London, W.C.2, and of
Messrs. HENRY BUTCHER & CO., 73, Chancery Lane, London, W.C.2. Telephone: HOLborn 8411 (8-lines).

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Rowland Fettling Grinder. With 30in. × 2¼in. wheels. For sale.—BOX D23, MACHINERY, Clifton House, Euston Road, N.W.1.

British Jeffrey Diamond Flex-tooth Crusher. Size 24in. × 20in. Driven by 17 h.p. motor 400/3/50. New in 1959.—Offers to BOX D22, MACHINERY, Clifton House, Euston Road, N.W.1.

Huller UG3 Tapping Machine, 1955. 400/3/50.—BOX C902, MACHINERY, Clifton House, Euston Road, N.W.1.

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Including Electric Motors, ARC and SPOT WELDERS, Bench Drillers and Grinders, "KEETONA" GUILLOTINE, "Manchester" Hack-saw, Metal Racks, "RICHMOND" MILLERS, "Universal" Grinder, "HERBERT" and PROGRESS DRILLERS, "PRATT & WHITNEY" and "CINCINNATI" DUPLEX MILLERS, Hand Shears, "EDWARDS" 6ft. POWER GUILLOTINE, "Myford" Lathe, "Landis" Threadmiller, "TOWNE" & "AMERICAN TOOL" RADIAL DRILLERS, "Asquith" Keyseater, "EDWARDS" 8ft. by 16 GAUGE H/D FOLDER, "GREEN-WOOD-BATLEY" 80-ton POWER PRESSES, quantity Steel Tube and Angle, "Goodwin" 3½ Concrete Mixer, and other Trade Equipment.

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Classified Advertisements (*SITUATION VACANT, contd.*)

Production and Planning Engineer required by well established Engineering Company in N.W. London. The post is a permanent staff appointment and a Life Assurance and Contributory Staff Pension Scheme is in operation.—Please write giving particulars of age, experience, qualifications, salary expected, etc., to BOX D14, MACHINERY, Clifton House, Euston Road, N.W.1.

Inspector required for Machine shop work. Able to line out castings for fabrications. Knowledge of hydraulics preferred but not essential. Good salary. Staff appointment. Only fully skilled need apply.—Apply PERSONNEL OFFICER, CHAMBERLAIN INDUSTRIES LTD., Argall Avenue, Leyton, E.10, or phone Mr. Howell, LEY 3678.

REPRESENTATIVES

Opportunity Knocks for young man, quick witted with good personality, to train with Machine Tool Firm, to take up position as Rep.; great possibilities.—BOX D10, MACHINERY, Clifton House, Euston Road, N.W.1.

Engineers' Suppliers require Experienced Representative for S.W. London and the Home Counties, to take over and expand existing connection. Top salary offered to first class man. Car provided and all expenses paid.—Our present staff have been informed and replies should be addressed to Managing Director, BOX D17, MACHINERY, Clifton House, Euston Road, N.W.1.

REPRESENTATIVE

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T. BROWN, Sales Manager, PUREFOY UNIT TOOLING Ltd., Upper Tilt Works, Cobham, Surrey.

Specialist Salesman

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Applicants must be Practical Engineers with a knowledge of Forging Practice and be willing to visit companies throughout the United Kingdom. A motor car will be provided and usual out-of-pocket expenses.

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Please state details of experience and salary required to

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REPRESENTATIVE

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PATENTS—TRADE MARKS

The Proprietors of British Patents Nos. 673186 for "Improvements Relating to Pipe Couplings", and 746807 for "Pipe Connection", desire to enter into negotiations with a firm or firms for the sale of the patents, or for the grant of licences thereunder. Further particulars may be obtained from Marks & Clerk, 57 and 58, Lincoln's Inn Fields, London, W.C.2.

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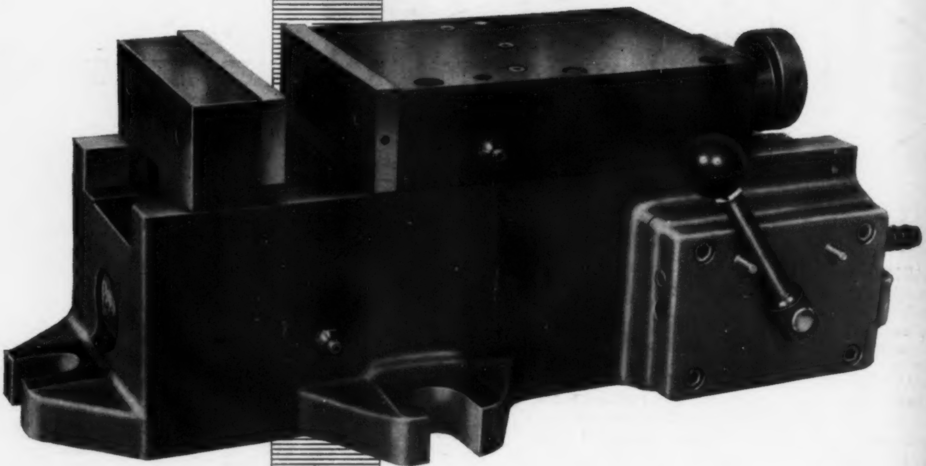

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